1915-01-02.pdf

1915-01-09.pdf

1915-01-16.pdf

1915-01-23.pdf

1915-01-30.pdf

1915-02-13.pdf

1915-02-20.pdf

1915-02-27.pdf

1915-03-06.pdf

1915-03-13.pdf

1915-03-20.pdf

1915-03-27.pdf

1915-04-03.pdf

1915-04-10.pdf

1915-04-17.pdf

1915-04-24.pdf

1915-05-01.pdf

1915-05-08.pdf

1915-05-15.pdf

1915-05-22.pdf

1915-05-29.pdf

1915-06-05.pdf

1915-06-12.pdf

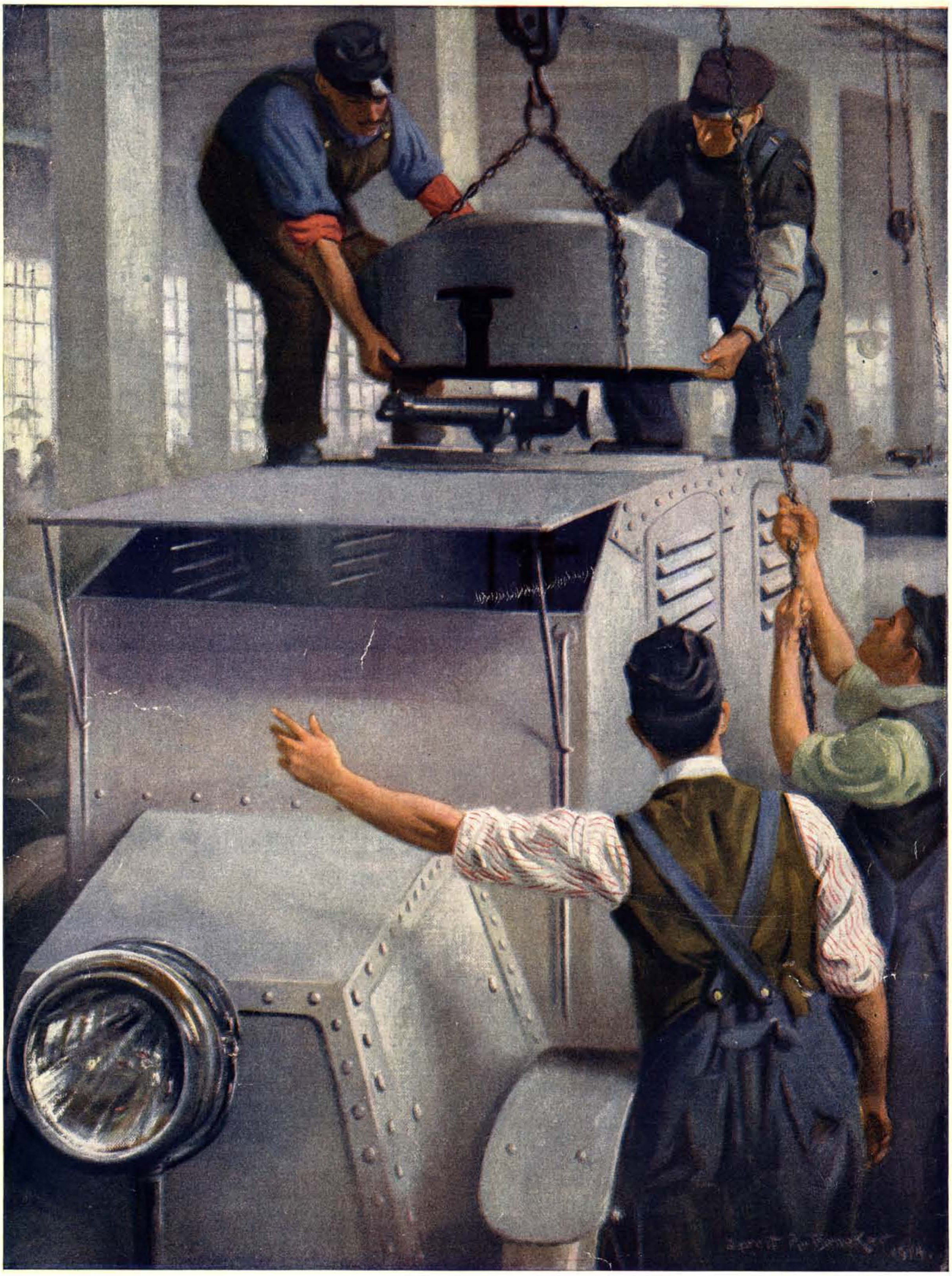
1915-06-19.pdf

1915-06-26.pdf


SCIENTIFIC AMERICAN
6000
6000
AN ILLUSTRATED
JOURNAL of SCIENCE MECHANICS AND THE ARTS
Vol. CXII.
MUNN & CO. NEW YORK

SEVENTEENTH ANNUAL MOTOR NUMBER

# SCIENTIFIC AMERICAN

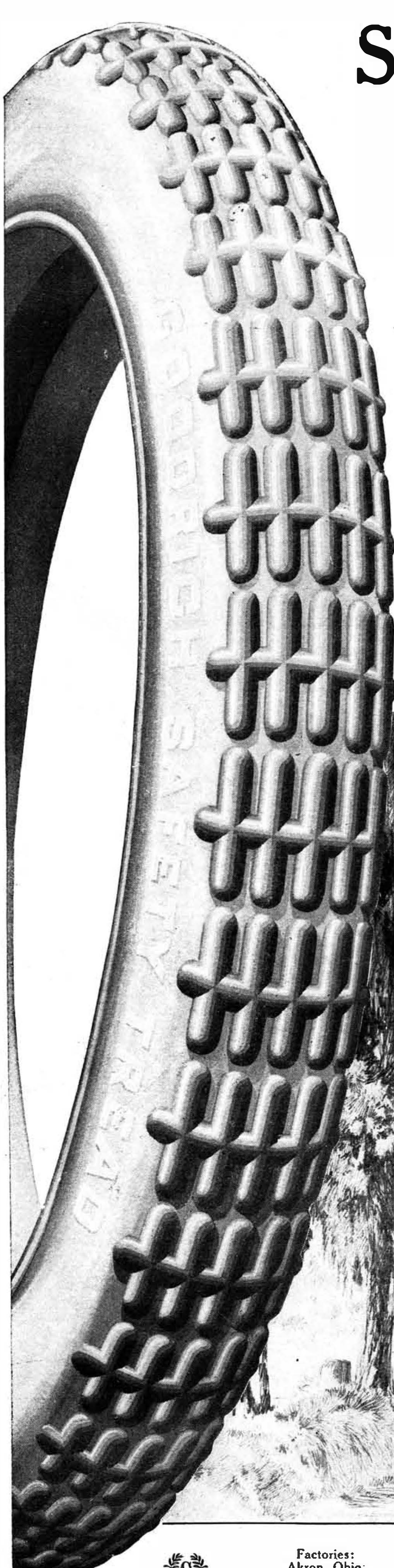


Vol. CXII. No. 1
January 2, 1915

Munn & Co., Inc., Publishers
New York, N. Y.

Price 15 Cents
$3.00 A Year

RODIN LE PENSEUR
THE WHITE
— a masterpiece
The distinguishing characteristic of a masterpiece is harmonious perfection
Every line in the marble, every color in the picture, every thought in the book, belongs to and blends into the complete creation.
An analysis of White Motor Cars—line by line and feature by feature will bring out many thoughts, each one of which will seem to be paramount.
The complete elimination of the conventional back of the front seat—always awkward in appearance—through the accomplishment of the finally-perfect stream-line body, may impress many people as an unusually important thing.
And it is. Yet, in viewing The White, the eye is led naturally and easily along until at last the mind holds, as in the beginning, the picture of the complete car.
White leadership is a principle
Many mechanical features that are "new" today were perfected and presented in The White long ago. 1909 saw The White with the first mono-bloc, long-stroke, high-speed motor—the very type which now is heralded as a sensation.
In 1910 The White presented the logical left-side drive with center control, and in 1911 The White introduced electrical starting and lighting with the tremendous advantage of a non-stallable engine.
From time to time other important improvements have been brought out, and today The White holds a position peculiar to itself in that mechanical excellence has been matched with external beauty.
The latest White Motor Cars are now exhibited by all White dealers.
THE WHITE COMPANY
CLEVELAND
Manufacturers of Gasoline Motor Cars, Motor Trucks and Taxicabs.




# See America First
# —on Goodrich Tires

This is America's big tourist year. The nation comes into its own as the sightseer's paradise. From Florida to California—from the lakes to the gulf—in the west and in the south, will be found—newly discovered—an American Tyrol—an American Riviera—a new Naples, and "Switzerlands"—beauty spots without number.

Take your pleasure on Goodrich Safety Treads. Make the short tour or the long journey safe, sure and profitable with these great big, service-performing

## Goodrich Safety Tread Tires

which are the winter resort favorites at Palm Beach, at Santa Barbara, at San Antonio, at the resorts throughout the length of the land.

Goodrich Safety Treads are found on the cars of those who know quality and service at first hand.

Goodrich Tires are the world's standard in built-in serviceability and price.

Tire history has been made by Goodrich.

The unit molding, the rubber compounding, the tread density, the "Safety First" design, and the positive tractive and non-skid results, belong to Goodrich and to none other.

These qualities are exclusive and can not be duplicated in other tires.

No other tires in the world today, are backed by a rubber experience of nearly half a century.

No tires can show better service records.

In price, Goodrich is the standard, as in everything else, and year in and year out Goodrich gives you the best tire at the best price, with long mileage, comfort and safety thrown in for good measure.

*Automobile road on Florida East Coast*

Factories: Akron, Ohio

**The B. F. Goodrich Company**

Branches in All Principal Cities

*There is nothing in Goodrich Advertising that isn't in Goodrich Goods*

SEVENTY-FIRST YEAR

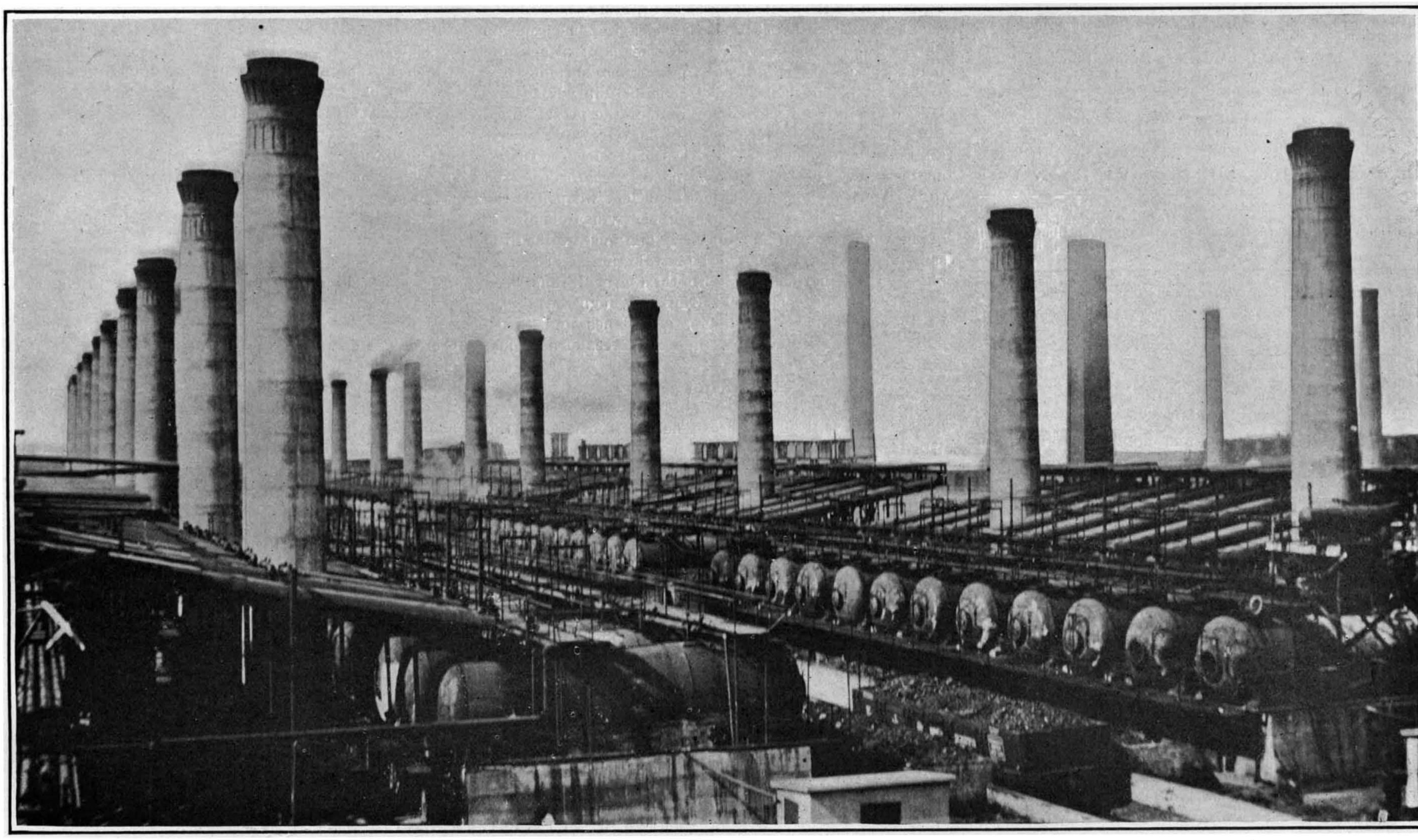
SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

VOLUME CXII.
NUMBER 1.

NEW YORK, JANUARY 2, 1915

15 CENTS A COPY
$3.00 A YEAR



**Plant for producing gasoline by the Burton process of distillation under pressure.**

## The Burton Process of "Cracking" to Make Gasoline

By C. H. Claudy

GASOLINE, not long ago a by-product of petroleum refining, has come to be one of the most important results of crude oil distillation. The rise of the internal combustion engine, and its rapid perfecting, due to the enormous increase in the manufacture of the automobile, has not only created a tremendous demand for gasoline for the motorcar, but has spread the doctrine of cheap and easily secured power throughout the world, so that motorboats, aeroplanes, farm engines, and other light motor apparatus use probably in the aggregate as much, if not more, gasoline than do the automobiles.

In this country there are at least 1,000,000 automobiles in use. Production of automobiles is an unknown quantity, since the manufacturing census, taken every five years, is not yet available for 1914, and the 1909 census throws no light on present-day conditions. But with one single factory announcing its hope of completing 300,000 machines in one year, and several others stating that they will produce from 25,000 to 50,000 machines in a year, it would surprise no one that in 1915 half a million machines were added to those already rolling on our 1,200,000 miles of roads.

The demand for gasoline has thus surpassed that for kerosene, once the main product of crude oil refining, to such an extent that were it not for the education of many foreign peoples to the advantages of the use of kerosene its production would have to be curtailed, which in itself would curtail the production of gasoline and thus raise its price.

In the early days of crude oil refining the various hydrocarbons were separated from crude petroleum and from each other entirely by the process of fractional distillation, the lower heats driving off the gases and then the liquids of lowest specific gravities and boiling points, the first rise in temperature separating the liquid of next highest specific gravity and boiling point, and so on, until all the usable gases and liquids had been distilled, leaving a residue which represented loss. The process can be expressed in a homely manner by comparing crude petroleum to a pile of stones of all sizes—immense boulders representing the heaviest oils, smaller ones the lighter oils, cobblestones the liquids which we know as the naphthas, benzines and gasolines, and pebbles the gases. The process of fractional distillation is a mere sorting of these various stones into different piles, each pile of which contains substantially only stones of the same size, weight, and composition.

Such a process, however, does not yield enough cobblestones for the present-day market. The yield of gasoline through simple distillation of crude petroleum will vary, of course, with the character and composition of crude petroleum used. An analysis of crude shale oil, which may be considered a fair average, shows gasoline and naphtha to be not quite 7 per cent of the total, the burning oils not quite 32 per cent, heavy oils and paraffine scale about 39 per cent, and the rest loss.

It is obvious that if every barrel of forty-two gallons crude oil yielded less than four gallons of gasoline, the United States could hardly export 183,000,000 gallons of "motor spirit" in 1913, in addition to her own enormous consumption, even with a crude oil production of 9,328,755,156 gallons of petroleum for the year.

So recourse is had to a process known as "cracking," a highly illustrative name for destructive distillation. Reverting for a moment to the several piles of stones, it will be readily understood that the man who wanted a lot of cobblestones and did not find enough in his miscellaneous pile would probably invest in a few hammers and proceed to crack some of his larger boulders into appropriate sizes.

It has been known for a long time that when petroleum is subjected to high temperatures, but without pressure, the hydrocarbons contained in it can be broken up or "cracked." Most of the hydrocarbons contained in petroleum belong to the so-called paraffine group, of which the general formula is $C_nH_{2n+2}$. When these paraffine hydrocarbons are decomposed it is the general rule that the resulting hydrocarbons consist in part of members of the ethylene or other unsaturated series. Just what does take place in this connection is not known, but we do know that the specific gravities and boiling points of the resulting hydrocarbons after such "cracking" has taken place are, in the main, lower than existed in the original material.

In the Burton process of "cracking" to produce gasoline, now in use by the Standard Oil Company, and for which a $700,000 plant has been erected at Whiting, Ind., this difficulty is overcome. Strangely enough, the inventor of the process can offer no satisfactory explanation of why it is successful where other and not greatly dissimilar processes fail. In dealing with chemical operations in manufacturing industries, it is often possible to get a result, and to know the exact means by which that result is attained, without knowing the reason underlying the process. Exactly the same thing occurs when we turn an electric current into a motor and produce power. We know how to do it and the means we must employ, but *why* an electric current produces magnetism and *why* magnetism acts as it does we know no more than the most ignorant savage.

The Burton process employs a container or still, provided with a proper fire box, a safety valve, a pressure gage, a temperature gage, etc., from which a pipe rises on an upward slant, which pipe is later curled into a coil contained in a tank where it is cooled with water. This pipe further leads to a reservoir, where the products of distillation collect. Beyond the condensing coil and just previous to its entry into the collecting tank is a valve. At the lower end of the coil in the condenser is a vent pipe, also provided with a valve.

The reader unfamiliar with this apparatus will see at first glance little to differentiate it from any apparatus for destructive distillation under pressure. The great difference comes in the point at which the valve is placed. In previous apparatus the valve was placed *between* the still and the condenser. By leaving such a valve closed while heat was applied, pressure could be put upon the liquids in the still, thus raising their boiling points and accomplishing a form of "cracking." For no reason which can be understood, such methods, however, when applied to fuel oil of the paraffine group formula, resulted *mainly* in gasolines of the objectionable ethylene group, with the general formula $C_nH_{2n}$.

*(Concluded on page 32)*

# SCIENTIFIC AMERICAN

Founded 1845

NEW YORK, SATURDAY, JANUARY 2, 1915

Published by Munn & Co., Incorporated. Charles Allen Munn, President; Frederick Converse Beach, Secretary Orson D. Munn, Treasurer all at 361 Broadway, New York

Entered at the Post Office of New York, N. Y., as Second Class Matter
Entered as Second Class Matter at the Post Office Department, Canada.
Trade Mark Registered in the United States Patent Office



**Subscription Rates**

| | |
|---|---|
| Subscription one year | $3.00 |
| Postage prepaid in United States and possessions. Mexico, Cuba, and Panama | |
| Subscriptions for Foreign Countries, one year, postage prepaid, | 4.50 |
| Subscriptions for Canada, one year, postage prepaid | 3.75 |

**The Scientific American Publications**

| | |
|---|---|
| Scientific American (established 1845) per year. | $3.00 |
| Scientific American Supplement established 1876. " " | 5.00 |
| American Homes and Gardens " " | 3.00 |

The combined subscription rates and rates to foreign countries including Canada, will be furnished upon application
Remit by postal or express money order, bank draft or check

**Munn & Co., Inc., 361 Broadway, New York**

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

*The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.*


## Review of the Year 1914

### Army and Navy.

ANY review of naval and military affairs must necessarily take account of the lessons which have been taught by the great World War. Limitations of space prevent any review here of the events of the war; that must be left to be dealt with in detail in a later issue. It is sufficient in the present review to draw attention to the fact that from the opening days of the conflict to the present hour the theories on which modern armies and navies, with their elaborate and complicated *matériel*, have been built up have been vindicated to a degree and with an exactness which is really wonderful. As regards war on the sea, it has been demonstrated that battleships are the backbone of any navy, that upon these all the other units depend, and to the battleship's efficiency they all minister. Proof of this is seen in the fact that it is the preponderance of the British battleship line which for nearly half a year has been holding the main German fleet inactive within the shelter of its own harbors. In all the engagements which have taken place between the minor units—cruisers, destroyers, etc.—victory has always lain with the fleet which possessed the heavier artillery and the speed to enable that artillery to be used at most advantageous range. That much-debated type, the battle-cruiser, so far as it has had opportunity, has abundantly vindicated itself, a notable case in point being the destruction of Admiral von Spee's squadron in the South Atlantic. The scout-cruiser of high speed has proved its value on all the seven seas; as witness the wonderfully successful commerce-destroying work of the German scout-cruisers "Emden," "Karlsruhe" and their sisters, and the exploits of the British "Undaunted" and "Arethusa," designed as destroyers of destroyers, which, in the case of the "Undaunted," sank in one morning four German destroyers in a running fight. No less effective, as a type, has been the large, well-armed and swift destroyer. To these vessels has fallen, very largely, the difficult and dangerous work of maintaining a close blockade of the German ports. On only two occasions have the Germans broken through for a raid along the coast of England. The destroyer flotillas have been the object of ceaseless attack by submarines, several of which they have sunk by ramming. It is noteworthy that by keeping a sharp lookout and by dexterous use of high speed and the helm the destroyers have usually been able to detect and avoid the torpedoes of the enemy. The early losses of the British by submarine attack proved that it was impossible for the larger cruisers to maintain a close patrol of the enemy's shores. It is probable that ships of the size of the "Cressy" have been withdrawn farther off shore, and that to the swift destroyers has been allotted the work of forming the inner lines of blockade. The submarine has done exactly what the naval experts believed it would do, by forcing the larger and more valuable ships of the enemy to remain far from the home coast line. Nowhere has the German officer proved his efficiency so thoroughly as in the submarine service. Such good work has he done with the coast-defense submarines of moderate size that the advent, at an early date, of the sea-going submarine of large size and battleship speed is a certainty.

As regards the war on land, unquestionably the most impressive fact is the controlling influence which has been exerted upon the strategy and tactics of war by the aeroplane. Aerial scouting has robbed military strategy of that element of secrecy upon which it was so largely based. Particularly has this been evident in the operations in France and Belgium, where, owing largely to the foreknowledge by each Commander-in-Chief of the projected attacks of the enemy, it has been possible to maintain a balance of forces on all parts of the battle line, which has brought about conditions approaching those of a stalemate. The wide turning movement, the surprise attack in overwhelming force, splitting the enemy in two and defeating him in detail, and many of the other decisive maneuvers which carried Napoleon like a thunderbolt through Europe, are gone never to return. Field artillery has added to its reputation as the controlling element, other things being equal, in modern battle; and the stream of machine-gun bullets has established itself as a means of attack and defense, second only in deadly efficiency to shrapnel fire. In fact, it is shrapnel and the machine gun which have been doing the wholesale slaughter of the present war.

One of the great surprises of the war was the size and deadly efficiency of the German siege artillery, against whose fire the Belgian and French forts proved to be utterly helpless. The most efficient weapon is the 11-inch howitzer, which, it now appears, has done most of the work of fort reduction. The gun has attained the same mastery of the fort as the naval gun has of armor-plate on the battleship. More than ever it has been proved that the mobile field army, thoroughly equipped with field artillery, howitzers, aeroplanes and transport, is the main reliance of the land forces of a nation, either for attack or defense.

### Civil Engineering.

So surpassing has been the public interest in the war that great events in the broad field of science and the arts have transpired with but a passing notice. Conspicuous among these has been the opening of the Panama Canal to the world's shipping. In spite of the great Cucuracha slide, the new and powerful dredging plant has opened and maintained a channel sufficient for the passage of ocean ships of large size. The growth of traffic has been steady and very encouraging, particularly in the trade between Atlantic and Pacific ports of the United States. Except for the slides of Culebra, which were expected and can be controlled, this great work has functioned admirably; and it stands to-day as a noble tribute to American engineering and executive ability. The formal opening will take place early in the spring of this year.

Rivaling the Panama Canal opening in importance was the completion of the enlargement of the Kiel Canal, which took place last summer. The normal width of the canal is now 335 feet on the surface and its depth is 36 feet. The twin locks at each end are 1,092.6 feet in usable length and 147.6 feet in width, as against a length of 1,000 feet and a width of 110 feet of the locks at Panama. The work of reconstructing the canal cost $55,000,000. Its strategic value in the present war is simply inestimable. Another canal of great importance to maritime commerce is that at Cape Cod, which shortens the distance between Vineyard Sound and Boston by about seventy miles, and enables vessels to avoid the exposed and stormy waters of Nantucket Sound and Cape Cod. Work has progressed steadily on the enlargement of the New York State Barge Canal, extending from the Great Lakes to the Hudson River, whose total cost, with the fifty terminals to be constructed along its course, will be about $128,000,000. Including its branches, the canal system totals about 790 miles of navigable waterways; 440 miles of this has been constructed and the remaining 350 miles lies through canalized streams. Work has progressed satisfactorily on the great Catskill water supply which will bring 500,000,000 gallons of mountain water into New York per day through an aqueduct ninety miles in length, and distribute it through a 12-foot tunnel built several hundred feet below the surface of Manhattan Island. The great Ashokan dam in the Catskills and the aqueduct leading into the city are practically completed and water may now be brought from the Catskills to augment the supply in the Croton Reservoir. An important work nearing completion is the great lock of the Government canal at Salmon Bay, by which shipping will pass from Puget Sound at Seattle to Lakes Washington and Union. The lock is 825 feet long, 80 feet wide, and 56 feet high. A vast national work of reclamation which has been the object of much favorable attention by the people of the Netherlands is that for filling in the greater portion of the Zuyder Zee. The scheme contemplates building an enbankment about 31,000 yards in length across the mouth of the Zuyder Zee and reclaiming 529,605 acres of land. The rentals from this land are estimated at $6,000,000 a year and the value of the probable crops $28,000,000. An important development in New York is the construction of a series of 1,000-foot docks to accommodate the large ships of the present day. The much-talked-of bridge (highway and railroad) across the North River has yet to be built; but during the year there was presented a most reasonable proposition and one that will probably be followed, namely, to have the bridge built by private capital and leased to the railroads and the States of New York and New Jersey, one half the rental to be assumed by the railroads and one half by the two States. The proposed bridge is to have two decks, one for highway traffic, the other for eight railroad tracks. The North River Bridge would have a central span of 3,000 feet, with main towers each about 600 feet in height. The Quebec Bridge, with a central span of 1,800 feet, the largest cantilever structure in the world, is making good progress. The piers are completed and the erection of the superstructure is under way. Another monumental bridge which has been greatly advanced during the year is the great 1,000-foot span, arch bridge, connecting the New Haven and Pennsylvania railroads, which is being built across the East River at Hell Gate. A vast engineering problem, work upon which has been pushed steadily through the year, is the control of the Mississippi River. There is a growing conviction that the method of embankment and revetment adopted by the army engineers is the only possible way to solve the problem, and earnest efforts are being made to induce Congress to appropriate sufficient money to enable this work to be pushed to completion with all the men and mechanical appliances that can be crowded upon the work.

### Merchant Marine.

The most important event of the year in connection with the merchant marine was the signing of the seventy-four articles of the Convention of the International Conference on Safety of Life at Sea, which met at the close of last year in London. The most important findings are those affecting construction of ships; and on this point the Convention provided that the degree of safety shall increase in a regular and continuous manner with the length of vessels, and that vessels shall be as completely subdivided as possible, having regard to the services for which they are intended. Although the work of the Conference did not go as far as we could have wished, the ratification of the Convention by the various maritime nations will mark a great step in the direction of providing safer travel on the high seas. Unfortunately, Congress is still debating the question of ratification; and it seems likely that the safety of the general public is to be sacrificed to the convenience of the seamen. The importance of this matter was emphasized during the year by the sinking of the "Empress of Ireland," which went down in twenty minutes after collision, with the loss of about 1,000 souls. Further emphasis was laid upon the question by the burning of the "Volturno," in which it was proved that the ordinary type of lifeboat is practically useless when the disabled ship is rolling heavily in a seaway. Two more of the vast 900-foot passenger steamers have gone into commission during the year, the "Vaterland" and the "Aquitania." The former, built by Blohm & Voss for the Hamburg-American Line, is 950 feet in length, 100 feet in beam, and displaces 58,000 tons. The "Aquitania," built on the Clyde for the Cunard Line, is 901 feet long, 97 feet broad, 92 feet deep to the boat deck, and has a displacement of 53,000 tons on a draft of 36 feet. There was launched during the year by Blohm & Voss a sister ship to the "Vaterland," the "Bismarck"; and at Belfast there is nearing completion for the White Star Line the "Britannic," a somewhat enlarged "Olympic," which embodies in her hull construction all the recommendations of the London Convention as regards safety subdivision. The steam turbine continues to demonstrate its superiority as a drive for large, fast ships, and the success of the various types of transformers indicates that ultimately a combination of turbine and transformers, and to a less extent of oil engines and transformers, will become general. The mechanical drive of Westinghouse, the hydraulic reduction gear of Foettinger, and the electric reduction gear as used on our collier "Jupiter" have all shown excellent results. Certainly the most remarkable development in this direction has been the decision of our navy to install electrical reduction gear on our largest battleship, the 32,000-ton "California." This action was taken as the result of the excellent results obtained on the collier "Jupiter." The merchant marine of the world continues to show marvelous growth, Great Britain leading with a tonnage nearly one third greater than that of all the other maritime powers combined. The totals are: Great Britain, 20,275,791 tons; Germany, 4,998,746 tons; United States, 3,489,736 tons, chiefly domestic shipping; Norway, 2,475,323 tons; France, 2,246,504 tons; Japan, 1,700,062 tons, and Italy, 1,571,761 tons.

### The Steam Railroads.

The most interesting development among the steam railroads is that occurring in the motive power. Although the electrification of the New Haven Railroad has been completed as far as New Haven and the electrical service is in successful operation, and although, particularly in the mountain districts, some important changes from steam to electric power are taking place, there is as yet no indication of that general

substitution which used to be predicted a few years ago. Undoubtedly electrification has been postponed for many years, at least, by the recent remarkable developments in superheating. It has been found that the use of large cylinders, moderate pressures, and superheat produces an improvement in the efficiency of the simple locomotive which is truly remarkable, amounting to 25 and in cases even 30 per cent. The promises held out when compounding was introduced, and never fully realized, have been more than realized in the introduction of superheat. The locomotive continues to grow in size, as witness the appearance of the large pusher freight locomotive built by the Baldwin Works for service over the heavy grades of the Erie Railway. The engine is a Mallet compound; but its weight and power have been increased by adding a third pair of cylinders and a set of six-coupled driving wheels carried by the frame of the tender. The boiler has 6,886 square feet of heating surface, and the steam is utilized in one pair of high pressure and two pairs of low pressure cylinders. The diameter of all cylinders is 36 inches and the stroke 32. The working pressure is 210 pounds and the drawbar pull 80 tons. The total weight of this huge engine is 477½ tons, of which 376½ tons are upon the drivers. The general movement in the direction of safer travel received impetus this year through the introduction of the new Westinghouse brake with electric control. A twelve-car steel train, 1,000 tons in weight, running 60 miles an hour, was stopped within its own length of 1,000 feet. The maximum brake capacity was obtained in 3½ seconds as against 8 seconds. A twelve-car train running 80 miles an hour can be stopped within 2,000 feet. That railway travel may be made perfectly safe, even where it is heavily congested, is shown by the experience of the New York Subway, which during the year pointed with great pride to the fact that its lines have carried 2,198,000,000 persons in the last nine years without a single passenger fatality, and this in spite of the fact that the speed and frequency of this train service are unsurpassed anywhere.

### Electricity.

Undoubtedly the most important scientific event of the year was the discovery by Prof. Kammerlingh Onnes that when certain metals are cooled to a temperature near absolute zero they cease to have any measurable electrical resistance and a current started in a coil thus cooled will continue indefinitely, without any appreciable diminution. Whether this discovery will ever have any commercial application in the field of electrical engineering it is impossible to say. At present it seems unlikely, and yet all our electrical machinery of the present time had its beginning in experiments that seemed just as impracticable, from a commercial point of view, as this one. Turning to the practical side of electricity, the present war shows how indispensable this form of energy has become. We find it used in the telephone and telegraph, both by wire and through the ether; it is used at night to throw powerful beams of light; in the hospitals to locate bullets; in camp for sterilizing water. In this connection we might refer to the new United States Army portable wireless station, consisting of a motor vehicle equipped with a powerful apparatus that has transmitted messages a distance of 800 miles under favorable conditions. Wireless telegraphy has been successfully used to send messages from aircraft. With a small apparatus weighing altogether 15 pounds, the British government has been able to transmit communication from an aeroplane over a distance of twenty miles. Turning to more peaceful pursuits, wireless telegraphy has been used by the Fire Department of New York to keep fireboats in touch with headquarters and also with incoming boats that are afire. The success of this system points to the possibility of providing a deep-sea fireboat service. Before the war wireless weather service was established in the North and Baltic seas under German auspices. Significant of the intense interest in wireless telegraphy displayed by amateurs is the league, recently formed, establishing relay stations all over the country, so that messages may be relayed from Maine to California. Wireless telephony has shown progress this year. Messages were exchanged between Berlin and Vienna, a distance of three hundred miles. A portable wireless receiving outfit mounted on an automobile received spoken messages from the Eiffel Tower at a distance of sixty miles. There has been marked electrical development in the field of motor vehicles, particularly in the introduction of electrical devices on gasoline motor vehicles. To encourage touring, road guides have been distributed among electric vehicle owners in certain parts of the country, with directories of electric garages where batteries may be recharged. In Vienna, after a fifteen-month test, forty-five electric mail trucks were purchased, each of two and one half tons capacity, and with a range of twenty-two miles. An electric tractor used by the Pennsylvania Railroad for moving freight cars through streets showed, in seven months, a saving of nearly 50 per cent of the cost of operation had horses been used. There has been some progress in the electrification of railroads during the year. The New York, New Haven & Hartford system has extended its electrified zone from Stamford as far as New Haven. In Norway the government is converting its steam railroads into electric lines. Work has already begun on the Christiania-Drammen Railroad, and the government is buying up as many falls as possible to provide sufficient current for the entire railroad system of the country. Of local interest is the hydro-electric plant at Washington, D. C., authorized by Congress. By damming the Potomac 99,000 horse-power will be available. There have been many novel and curious uses for electricity during the year. In Argentine a method has been devised of electrocuting grasshoppers and their eggs. A portable plant capable of developing a tension of 6,000 volts energizes a wire screen which is placed over the ground to be treated, and by this means the insects are destroyed. Trees are similarly treated with metallic brooms having insulated handles. Some advance has been made in electroculture. One experimenter has shown that repeated applications of Roentgen rays for periods of one hundred and fifty seconds have a marked stimulating effect upon the growth of the plant. In one of our western towns a high school has been equipped completely with electrical apparatus and even with electric heating apparatus. No furnace man is required. We might continue *ad infinitum* to list the various novel uses of electricity that the year has brought forth, but the few instances cited will suffice to impress one with the continued growth and endless development of this branch of practical science.

### Aeronautics.

Although no striking innovations in aeroplane construction have been brought forward during the past year, nevertheless that important advances have been made in the science of aviation is evidenced by the more perfect control that is apparent, and the increased reliability and endurance of the later models. The general results of improvement are marked, and are due to refinements of details, largely the result of continued scientific study of the underlying principles, and the experiments conducted in the laboratories that have been established for the purpose. One direction in which these studies have made themselves evident is in the increased flexibility in speed, and the possibility of flying at lower speeds than heretofore, it being recognized that the ability to vary the speed of a machine within wide limits is a practical necessity.

In the way of records there is little to report, the war intervening about the time the important competitions were due; but mention may be made of two flights from Paris to Cairo, one by way of Constantinople in eight stages. The altitude record appears to have gone to Linnenkogel, who attained 21,654 feet, as against 19,685 for last year.

A feature to which increasing attention has been given is automatic stabilizing, and many devices for the purpose have been invented, some of which have given really wonderful demonstrations of their powers, notably the gyroscope controlled device shown by Sperry in France.

The efforts for the improvement of aviation have been directed almost exclusively to purposes of warfare, but anything that tends to perfect aeroplanes in this direction will also be largely applicable to machines used for commercial purposes. As a fighting machine the aeroplane surpassed expectation, and for the work of scouting and observation it has proved invaluable in the present war.

More powerful motors have made possible machines of greater speed and also greater carrying capacity, as was evidenced last year by the appearance of the great Sikorsky plane; but development in this direction has apparently been slow.

What promised to be the sensation of the year was the flight across the ocean, in which but one candidate for the prize developed; but unfortunately, or possibly fortunately, the outbreak of hostilities necessitated a postponement of the plans.

It is interesting to note the experiments made by Curtiss with the flying machine built by Prof. Langley, which demonstrated that if a proper method of launching or starting the flight had been employed the flying machine would have arrived years ago.

### Automobiles.

The only really marked novelty in the automobile field is the very recent introduction of the eight-cylinder motor, which will undoubtedly give the even, continuous torque that means so much for smooth running and increased flexibility of power and speed that is expected.

Outside of this matter of motors, the story of the past year has been one of refinement in various details and perfected standardization and processes of manufacture. Bodies have come in for a large share of attention and more careful study has been given to the artistic harmony of lines and proportions. Special efforts have been put on electric starting and lighting, and in these directions considerable improvement is noted both in durability and reliability. Efforts are also being made to produce a satisfactory and reliable device for automatically changing gears and several on different principles have been introduced that indicate much promise.

Although motor trucks and commercial vehicles generally have arrived at a very practical stage, it is to be regretted that they have not been more generally adopted. The trouble appears to lie mostly with the users, who overload, abuse, and neglect their machines and then condemn. The demonstrations of the value of motor trucks in the operations in the European war, where they are absolutely indispensable, will undoubtedly tend to awaken the commercial user to their advantages.

The year opened with considerable interest in cyclecars, just about the time they were meeting the fate abroad that is sure to overtake an immature idea everywhere. While an interesting novelty, the cyclecar has been little more than a toy, essentially of French origin, and later taken up in England. It did not take long for the more practical men of that country to recognize the shortcomings and limitations of the design and to jump to a logical conclusion by bringing out the light automobile. In this country a swarm of promoters started a cyclecar movement, which, following the history of the English movement, has failed to show signs of vitality; but a few far-sighted men with better practical knowledge of the requirements of the road vehicle have introduced really good automobiles of light power and low price which will undoubtedly take a permanent position in the market. Whatever else the cyclecar may accomplish, it has at least served a good purpose in hastening the development of a type of car that will meet the requirements of a numerous class of people.

### Astronomy.

On July 21st Mr. Nicholson of the Lick Observatory photographed a faint object in the vicinity of Jupiter, near the eighth satellite, but still fainter. The new body proved to be a satellite of the great planet—the ninth to be discovered. This discovery is by far the most important of the year.

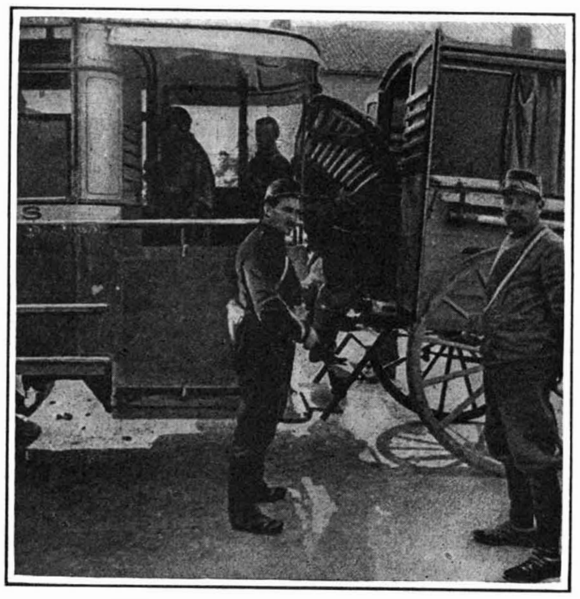
One of the principal events of the year was the total solar eclipse which occurred on August 21st. The most favorable stations for scientific observation were located in Russia. A number of expeditions established themselves at various points along the Russian part of the track. The intervention of the war unquestionably interfered with their work, but enough of them performed their tasks sufficiently well to complete the long record of eclipse observations.

On the 7th of November there was a transit of Mercury across the sun's disk. The scientific interest of a transit of Mercury is not very great, being confined to the exact observation of the times of the apparent "contacts" of Mercury with the sun's limb, which gives valuable data for determining its exact position in its orbit.

The first comet to be discovered in 1914 was detected by Dr. Kritzinger of Bothkamp, Germany, on March 29th. The second comet to be discovered in 1914 was found by Zlatinsky at Meitau, Russia, on May 15th. On September 18th Mr. Leon Campbell of the Harvard Station at Arequipa, Peru, discovered a comet which was also independently discovered at the Cape of Good Hope. Although Delavan's comet was discovered in 1913, it was a very conspicuous object in the October sky of 1914. Indeed, it appeared to the naked eye fully as bright as a third magnitude star and had a tail several degrees in length.

It has long been a question of much interest whether we receive heat from the stars, and if so, how much. Until recent years all attempts to detect and measure the almost infinitesimal amounts of energy which are radiated from the stars met with little success. No very great advance was made in this very difficult field until the present year, when Dr. Coblentz of the Bureau of Standards reported upon his work at the Lick Observatory. His apparatus will give distinct indications of the heat received from stars so faint as to be invisible to the naked eye. It was invariably found that for the same visual brightness a yellow star sends us more heat than a white one and a red star more than a yellow. Speaking roughly, Dr. Coblentz declares a yellow star of spectrum like the sun gives out twice as much energy for "heat" in proportion to its light than does a white star like Vega or Spica; while a red star like Antares radiates three times as much heat as a white one of the same apparent brightness.

The distinguished Dutch astronomer, Prof. Kapteyn, published an admirable investigation on the motions of stars which show in their spectra the dark lines of helium. As a result of his exhaustivs studies of the motion of helium stars, Prof. Kapteyn has obtained conclusive evidence that almost the whole of the stars of this type in a huge region of the sky, 60 degrees wide and 140 degrees long, extending for 30 degrees on each side of the Milky Way from Argo past the Southern Cross and Centaurus to Scorpio and Ophiuchus, are moving together relatively to the sun at least.



Loading a Paris stage with meat.

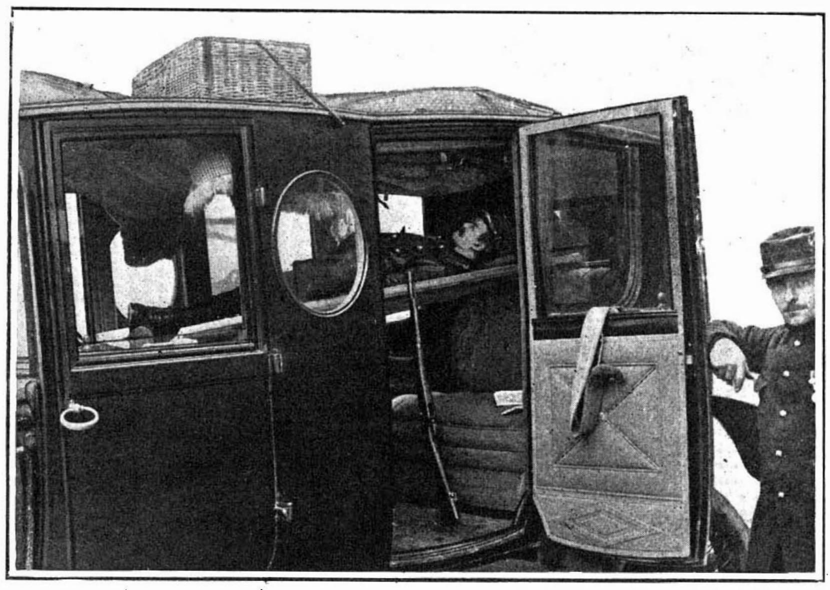
# Military Tactics and the Motor

## How the Power Vehicle Has Created a New System of Attack and Defense and Has Lessened the Chances of Cutting Off an Army from Its Base of Supplies

Chauffeur's port in Belgian armored car.

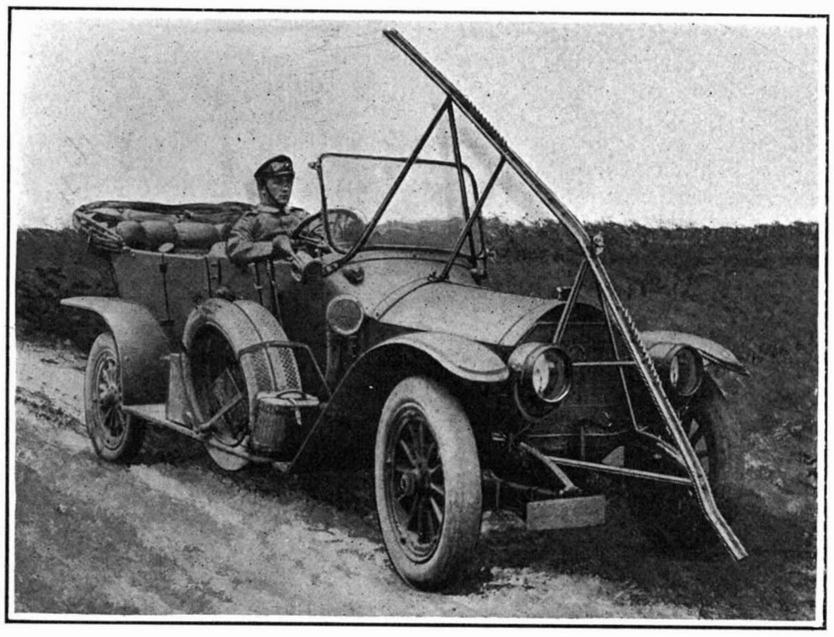
OUT of the chaos of conflicting and vague reports from the European battlefields there arises clear and pre-eminent the eulogy of the automobile and motor truck. Put to the test of war conditions for the first time since its invention, with the exception of its very limited use during the last Balkan war, the gasoline-driven motorcar has more than fulfilled the expectations of its advocates. It has almost become a tiresome "bromidiom" to say that the modern motorcar has been an important factor in the rapid concentration and transportation of armies, and that but for the motor the Germany army could not have succeeded in advancing to within twenty miles of Paris in the short space of four weeks. Even the most cursory reader of the daily press has been given to understand that the German attack in August was an attack by automobile. The attack failed; the armies have been locked in Flanders and along the eastern frontier of France for months. But the automobile has lost nothing of its importance. It has simply taken up other duties.

To give in detail all the work performed within and behind the battle lines in France and in Poland and Galicia would require a full issue of the SCIENTIFIC AMERICAN. So complete and important is the work of the motorcar that there is not a single military operation without its help or without feeling the effect of gasoline in some of its phases. From hurling heavy guns, machine guns, quick-firing cannon and armored cars at the enemy, to observing his operations behind the lines, carrying fodder and provisions for men and beasts: bringing aid to wounded, ammunition for the artillery and infantry; carrying high officers at express train speed between the various headquarters, and capable engineers from point to point along the battle line where their presence is most necessary, and a host of other incidental performances—all are "in the day's work" for the modern military automobile, and will continue until the end.



Photograph by Meurisse

How motor cars serve as ambulances.



Photograph by Paul Thompson.

Wire cutting guard used on German cars.

### Motorcar Resources.

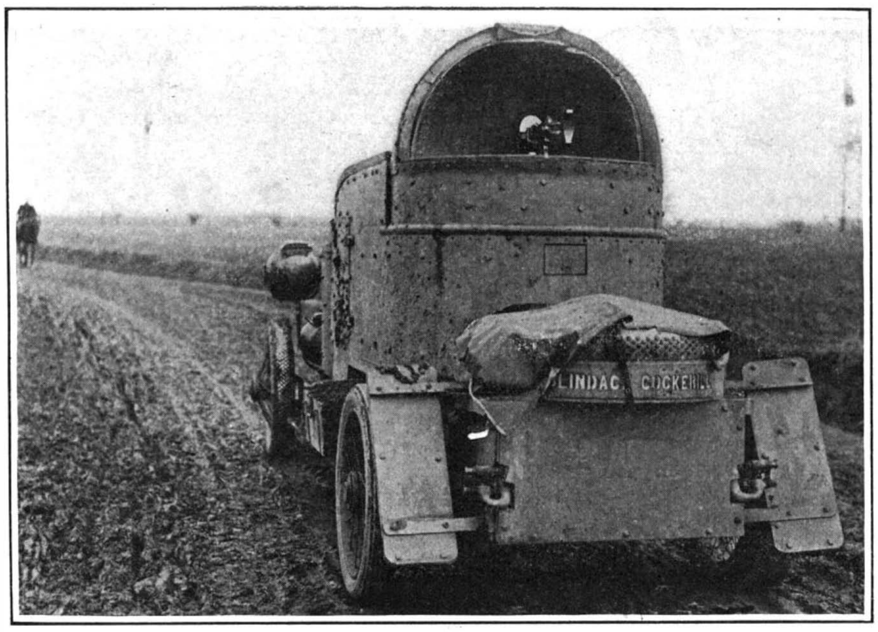
In speaking of the "resources" in motorcars in a country it is of course necessary to take into consideration that in Great Britain the government has not quite the same power to commandeer touring cars for the army as the Continental governments have. The Royal Automobile Club and its affiliated organizations have placed at the disposal of the British government about 15,000 touring cars, with drivers or owner-drivers, and the government itself has "impressed" somewhere near 6,000 motor trucks and has converted about 800 touring cars into armored cars by means of inclosing the car in thin steel shields. These converted touring cars, built to carry on an average not more than 3,500 pounds on the chassis, now are compelled to carry between 7,000 and 8,000 pounds, with the result that crystallization and breakage of chassis side frames is of rather frequent occurrence. In addition to strictly military vehicles, the government has received from private sources more than five hundred well-equipped ambulances, a great number of these being mounted on American chassis (Overland, Buick, and Ford).

In the case of France and Germany, the motorbuses and interurban motor passenger coaches have proved of tremendous value. Germany has an extensive system of passenger coach transportation run under the jurisdiction of the post office "mail coaches." More than 3,000 of these sturdy and capacious vehicles have been transformed into military vehicles, especially for meat transport to the front. The same must be said of the French buses, long lines of which may be seen at all times several miles behind the battle front.

The military authorities foresaw the great service that power wagons in general were called upon to perform in the event of war, and, as in all the leading countries, they endeavored to have all the

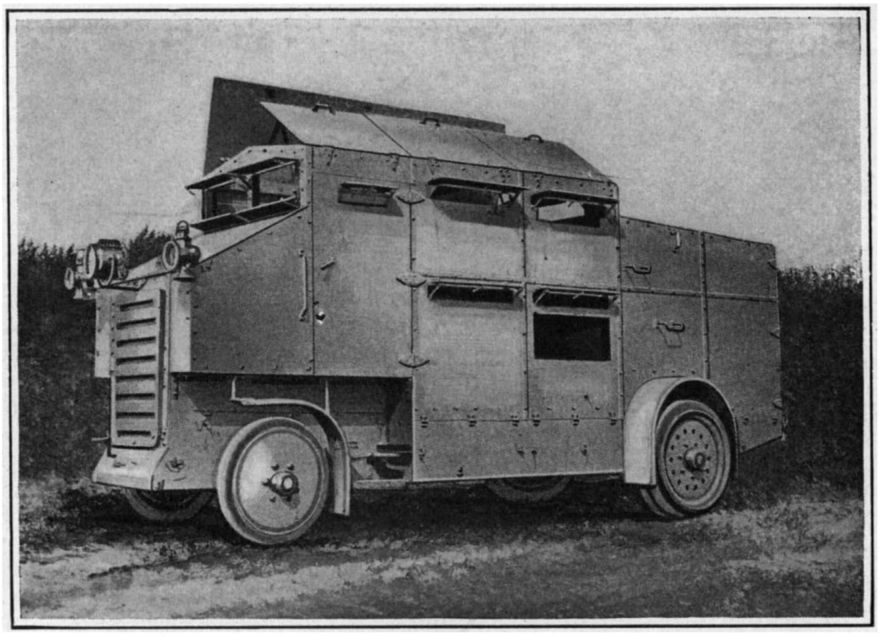
Copyright by Underwood & Underwood.

The Canadian contingent on review at Salisbury Plain, England. The cars were built in the United States.



Photograph by Meurisse

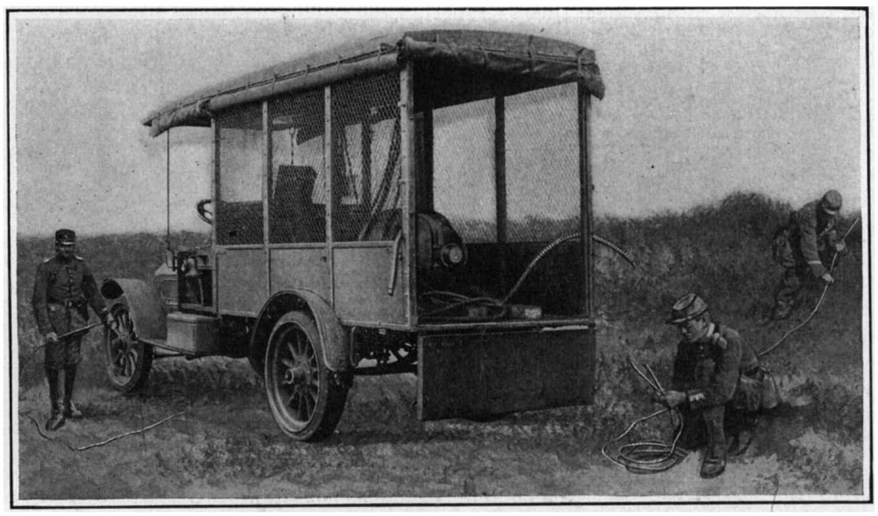
**Belgian armored car, showing the revolving turret.**



**Heavy English armored car, a fort on wheels.**

power wagon trucks including the ones used with autobus body, built according to the general standard regulations laid out by the War Department. In this way the trucks of the autobus are in reality a type of power wagon chassis which conforms to the same standard rules as apply to the larger power cars. The Paris bus employs two different types of motor and truck combination, one being designed by the Schneider works, the great artillery and machine works, and the second by the De Dion automobile builders.

Since the war broke out the autobuses have entirely disappeared from the circulation in the city and the whole number of these cars has been enrolled from the very outset of operations in the carefully planned service for supplying provisions to the army on the field. No less than 1,100 buses were thus available, and they are now engaged in following the troops in the course of the battle. About 900 of them were taken for the transportation of fresh meat in quarters, and the inside of the vehicle was quite transformed by taking out all the seats and partitions so as to leave a roomy space for holding the quarters of beef, these being, as a rule, hung upon hooks from the roof. A single autobus can hold a very large number of pieces, so that the whole fleet is able to handle enormous quantities of meat, such as are needed for the immense number of troops engaged in the war. The remainder of the vehicles, or about 200, are designed for the transport of troops, and this can be done in a very rapid manner on occasion, either to help out the railroad or in other cases where railroad facilities cannot be had. Again, for emergency cases or rapid maneuvers, a considerable number of troops can be instantly sent to a certain point of the battle either in autobus or on other kinds of power wagon, and this might often change the issue of events. It is also probable that a few of the buses are fitted out for ambulance work, and one of our photographs shows a bus transporting some of the Algerian troops.



**Motor truck fitted with an electric generator for field use.**

Photograph by Meurisse

**German prisoners conveyed by motor truck to Châlons sur Marne.**

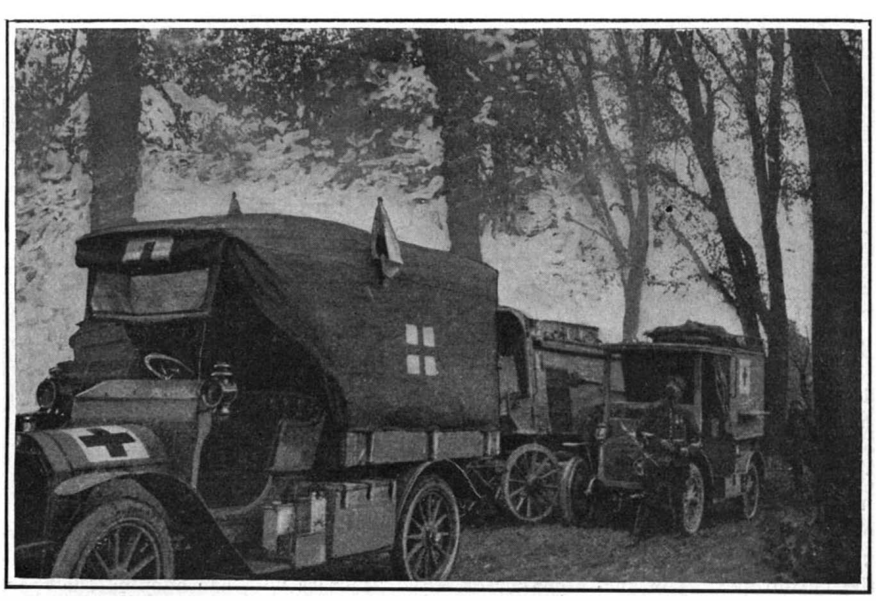
Owing to the careful construction of the automobile chassis and motor, the cars go through their daily work on the battlefield with their heavy loads, and the military authorities are more than satisfied with their performance. It was considered fortunate that just within a few years Paris had adopted the present extensive autobus system, which led to building over a thousand cars a short time before the war broke out. As to the way the cars stand the wear of this hard service, they say it is very good, and with the exception of three or four cars laid up and four or five in repairs all of the great fleet of buses continue to circulate over the roads.

Turning to the question of transporting the food supplies for the troops, and especially the handling of quarters of beef, the present organization is excellent. Large troops of cattle follow the armies over the roads and are convoyed by soldiers. At the headquarters where the troops are stationed a suitable place is selected in a town or village or at any chosen spot along the route and improvised abattoirs are installed, usually in buildings and grounds, where the mobilized butchers are at work slaughtering cattle and cutting up the beef in quarters. From the abattoirs the autobuses receive the meat, which the soldiers load upon the vehicles in rapid order; then the fleet of cars start off upon the road to a point lying nearest the battlefield. Here the meat is changed over to the covered army horse wagons of light build, and these are able to travel over fields or other ground so as to reach the rear of the fighting line; then the army cooks receive it and proceed to prepare the rations for the men.

**Watching the Motor at Work.**

The popular conception of lines of infantry in trenches, interspersed with motor convoys loaded with ammunition, etc., is pure folly. Motor convoys are miles

*(Concluded on page 32.)*



Photograph by Meurisse

**Convoy hiding in the woods from a hostile aeroplane.**


**Carrying supplies to the British troops.**

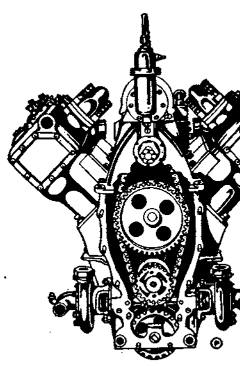
# The Car of 1915

## Some of the More Important Changes Ushered in With the New Year

By S. P. McMinn, M.E.

During the past twelvemonth there have been a number of developments in the motorcar world, which, perhaps, are not as plainly apparent to the layman as they are to the student of matters gasoline. Also, there are a number of trends of the times which must be plainly apparent to all who have eyes to see.

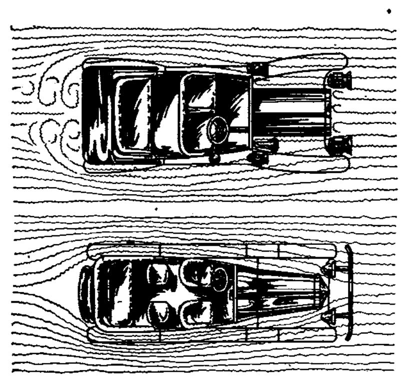
Not the least important of the developments of the past year has been the commercializing of the eight-cylinder motor. Or should we say popularizing, for the motor of this type long has been successfully used by our brothers across the seas. But it is characteristic of American progressiveness that those who have been instrumental in bringing the eight-cylinder motor to native heather have not been content to follow blindly the example set by French pioneers. In constructional features and design they might have looked far and perhaps in vain for better engineering in so far as the mere drawing of the plans is concerned. But engineering extends further than the draughting table; it extends out on the roads and comes close to the pocket-book of the ultimate consumer. So American engineers have been free and frank in their adoption of practice long acceptable abroad, but they have applied to it American engineering principles; which means, briefly, quantity production and a popular price. As a result, we now have two American eight-cylinder motors, one selling for just under $2,000 and the other selling for less than $1,500. Shall we have more? It seems more than likely.


**An eight-cylinder motor.**

From the eight-cylinder motor it is but a step to the motor with twelve cylinders. So far only one foreign maker has attained success with this type of motor, and here again it is characteristic of American progressiveness that already several well-known American makers are known to be experimenting with motors of the kind. Whether the experiments will bear fruit, whether we shall see twelve-cylinder motors competing with eight-cylinder ones, remains for the future to bring forth. And in this connection it must be remembered that there were those who were outspoken enough to predict that the eight-cylinder motor never would become popular under the American flag.

The light-by-comparison six-cylinder car which was such a feature of last year's crop of machines continues to hold its own, though it might require a stretch of the imagination to see it making the strides that were freely predicted for it. As a matter of cold fact, the still-lighter-by-comparison, small, high-speed, four-cylinder motor appears to have made greater strides in the year, and by comparison, than has the six. Another significant feature is the increase in the number of cars which sell at or near to the $1,000 mark.

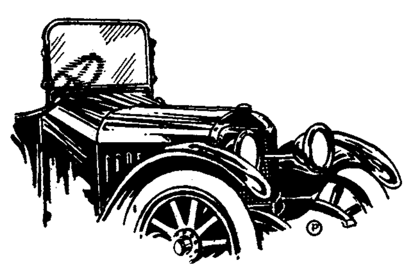
At the same time it is interesting to note that the well-defined division which existed between the miniature car and the larger one fast is disappearing. It has come to be regarded as distinctly unhappy and undesirable that there should be any division as between classes of cars. Instead there is a marked tendency to place all four-wheeled vehicles in the one class. The so-called cyclecar, for instance, has been practically pushed over the horizon, and it is now a motorcar pure and simple. This may also be taken to mean that the narrow tread appears to be passing. Already a number of makers of narrow tread cars have widened them to track 56 inches and others give evidence of appreciating the failing popularity of the narrow tread car by offering the option of either narrow or standard width.


**"Streamlines."**

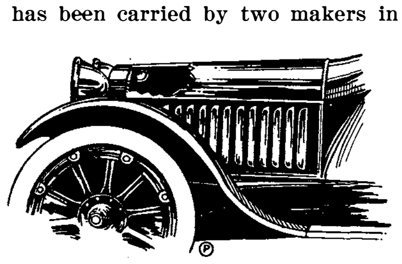
The outward appearance of the car of 1915 has not changed very much. Yet there is a subtle something which almost involuntarily brings to mind and expression the saying: "Clean as a hound's tooth." The blending of lines, which first gave promise about four years ago, when fore doors on touring cars were one of the dominating notes, has become an established fact, and practically every car, regardless of class distinction, now has the streamlines which last year were a feature of a comparatively few.

This term "streamline," by the way, has become a common one, yet there are not many among the ranks of motorists who know its significance. It means, briefly, that the designer has taken advantage of the entering wedge principle, and has at least in part converted wind resistance to his own uses. In other words, he has conserved some of the wasted energy represented by displaced atmosphere by training the eddy currents to help push the car along.

He has done this by tapering the engine hood and in some cases by fitting a pointed radiator; by gently flaring the body sides and carefully eliminating all external protuberances; by clearing everything off the running boards; by rounding the fenders; by giving thought to body lines at the rear, where once no thought was bestowed. The result, of course, is a much more efficient car and one which is driven on less gasoline and lubricating oil.

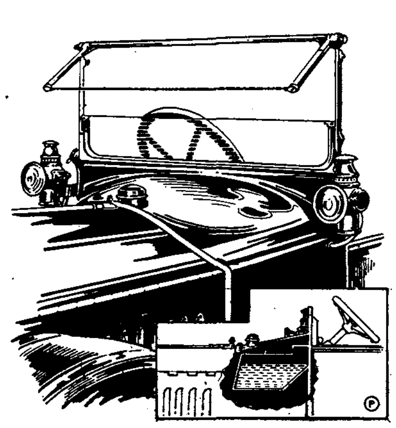

**The pointed radiator.**

Here are two notable examples of how far the smoothing process has been carried by two makers in the popular-price class. One of them has even eliminated the time-honored and not always sightly radiator filler. He has placed it beneath the engine hood, and in this way obtained smoothness where it was not obtainable before. The other has substituted for the usual door latches a magnetic device, which is entirely inclosed both inside and outside. To open the doors you merely press a button.

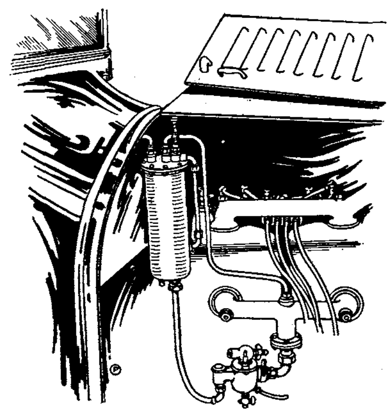

**The radiator filler concealed.**

Left side drive is now almost universal, and there is nothing new in that except its widespread adoption. There are not more than three or four makers who still adhere to the right side position for the steering wheel.

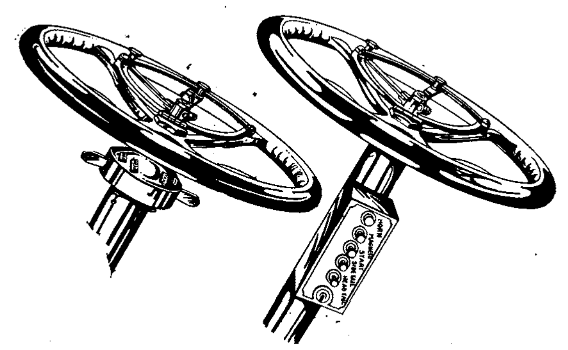
Quite generally, now, the fuel container is carried either beneath, or rather in, a deep cowl over the driver's feet where before there was waste space, or at the rear of the body. This was one of the noticeable tendencies last year. The cowl-located tank indicates no difficulty in feeding the fuel to the carbureter, for gravity may be relied upon. But the rear tank has been responsible for the development of a new method of getting the gasoline from the tank to the engine. The use of pressure feed is open to many objections, and now the necessity for it has been obviated by the development of what has come to be styled vacuum feed.


**The cowl tank.**

This vacuum feeding device, which now is quite common and bids fair to be more common, consists of a small tank placed generally on the forward side of the dashboard. There are two compartments to the tank, the upper compartment being connected to the main fuel tank and the lower to the carbureter. The suction induced in the intake manifold of the motor is caused, through suitable piping and valves, to draw fuel from the main tank into the upper compartment, whence it drains by gravity into the lower compartment and thence to the carbureter. The device is entirely automatic in action.


**Vacuum feeding device.**

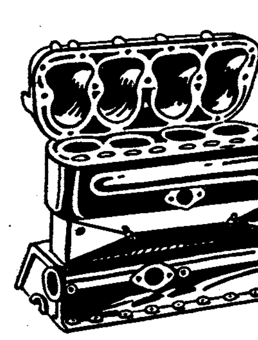
Along with the convenience that comes with center control of the gear shifting and emergency brake levers, there is a well-defined tendency to place all other control devices within easy reach of the operator. Thus, for instance, switches, carbureter adjustments, etc., now are being placed on what have come to be styled cowl boards, directly in front of the driver. At the same time, there is a noticeable trend toward the adoption of switchboard units mounted directly upon the steering column.


**Switchboard on the steering column.**

Wire wheels may now be had on the majority of cars at a nominal extra cost, though there are not many makers who supply them as standard equipment. That they have made some advance there is no gainsaying, though it likely will require another year before they are entitled to the descriptive adjective common.

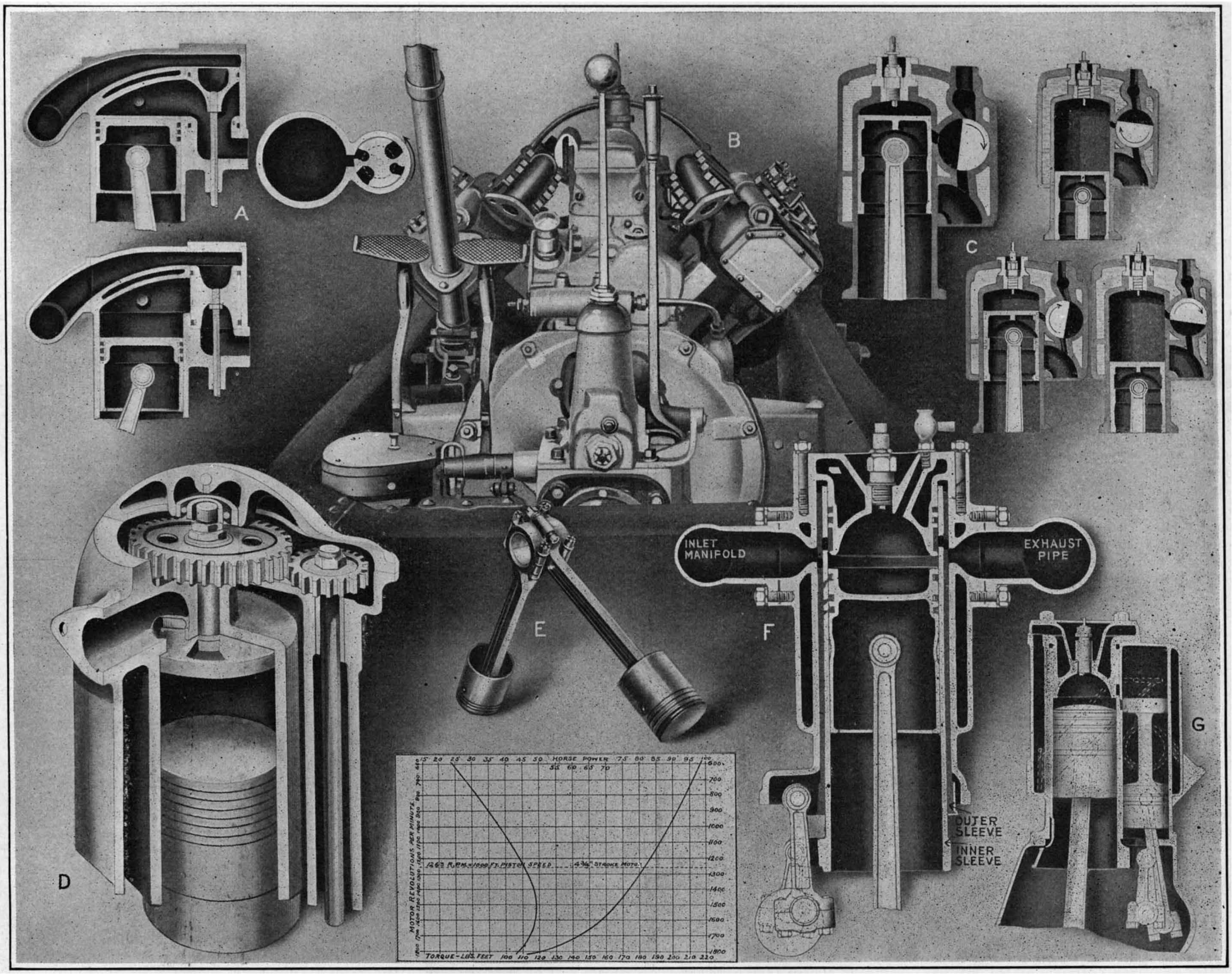
In the vitals of the car, one of the most noteworthy features, as already has been chronicled, is the increase in small-bore, high-speed, four-cylinder motors. The increase in the type has served to draw attention to the fact that the method of casting all four cylinders—and in the case of six-cylinder motors all six cylinders—in one block grows apace.

Another of the past year's developments which has lived up to its promise is the steadily increasing use of a detachable cylinder head. This construction simplifies somewhat manufacturing operations and at the same time increases accessibility and facilitates the easy removal of carbon deposit. The use of cored intake and exhaust passages also shows a slight increase. With the now almost universal adoption of electric lighting and engine starting equipment—there are not more than three or four makes of cars on which this equipment is not listed as standard—has come what may be styled a logical reversion to battery ignition. Given the storage battery as part of the car it is such a comparatively simple matter to arrange to draw current from it for ignition that quite a number of makers have eliminated high tension magnetos as a result. Others, however, prefer the proven reliability of the magneto and the complete isolation of ignition and lighting functions. But on the popular priced cars the modern battery ignition system, brought to the plane of perfection where mechanical and electrical lag has been practically eliminated, undoubtedly has won a place for itself and will not soon be ousted.


**Detachable cylinder head.**

The lightening of reciprocating parts goes forward, and of late still greater attention is being paid to the necessity for more perfect balancing. As a concrete example of this fact we might state the case of one maker of Knight motors who has adopted the practice

(Concluded on page 36.)




**Various types of high-speed motors.**

*A*, odd rotary valve action of the Italia motor; *B*, the eight-cylinder Cadillac motor; *C*, action of the Darracq D-form valve; *D*, the Reynolds rotating valve disk; *E*, pistons of the Cadillac motor; *F*, valve sleeves of the Knight motor; *G*, the Miesse combination sleeve and piston valve. The chart shows a laboratory test on a four-cylinder 5 by 5½ slow-speed motor for power and torque. The strangling effect of the valve is plainly apparent.

# The High Speed Automobile Motor

## Relief it Promises From the Growing Burden of Weight and Increased Running Expenses

By Charles F. Barrett

IN spite of the large amount of discussion and experiment on the subject of the high speed gasoline motor for automobile use, very little progress has been made so far on this side of the water in the perfection of such units along successful commercial lines. In France and Germany, and particularly in the former country before the war broke out, wonderful results had been attained with this type of motor, although not in any marked degree as regards size of output, when the latter is judged from our American standards.

On close analysis of the problems encountered in the commercializing of this type of motor in this country two or three facts stand out prominently as having a vital bearing on the situation. One of these is largely psychological; one a result of habit, and the third based upon actual structural difficulties.

The first two of these really date back to the very beginning of the industry in this country and relate to the early impression formed by motorists of the satisfactory speed of the motor as well as its control by the gear changes. Most of the pioneer manufacturers were so engrossed in the problem of actually making their motors run that they gave little heed to the important subjects of vibration and balance. The result was, naturally, a very disagreeable vibration whenever it was necessary to speed up the motors on either low or high gears, and a popular dislike was therefore created for small bore motors which of necessity required relatively low gears and frequent gear changing.

Consequently the demand was for large bore, relatively slow speed motors which could be geared fairly high and thus loaded down sufficiently to hold the unbalanced effect within reasonable bounds. The poor balancing evil thus caused an unwarranted prejudice against the high speed motor right at the beginning of the industry, and having once started in this rut manufacturers naturally took the path of least resistance and, instead of attempting to swing the public back in line, encouraged them to keep on believing that the slow speed motor was the correct type with no alternative.

Hand in hand with this development came a strong liking for high gear driving. The infrequent gear changing necessary with the large bore type of American automobile motor has undoubtedly taken firm root upon the majority of motorists in this country and the habit resulting from long use of this form of control has been practically a national characteristic.

It is therefore necessary to realize at the outset these two basic dislikes of the American for the high speed motor; one, an old, moss-grown suspicion that vibration and poor balance go hand in hand with high speed, and second, a genuine hatred for gears and gear changing. The latter feature cannot, of course, be separated thoroughly from high speed design, because the torque falls off so rapidly when the motor speed is pulled down that slow, high gear work under load is not practical, and gear changing must be rather frequently resorted to, with four cylinders or less.

It has taken years to overcome this deep-seated prejudice of the motorist in this country for the so-called high speed type of automobile motor and there is no assurance that it has been overcome even now, but there is at least some marked evidence of widespread kicking against the ever-increasing cost of the present type of motorcar, particularly as regards upkeep. This is beginning to cause a decided reaction in favor of the high speed type on account of the relief which it seems to promise for a very material reduction in the present burdensome total car weight with its chain of expense. In other words, we are fast getting into a mood to accept what appears like a lesser evil in order to overcome a greater.

It should be said for the large, slow speed type of motor, however, that during the early period of the industry it was unquestionably the most practical type from the purely manufacturing standpoint. Just as the introduction of the successful automobile itself was contingent upon the development of the high grade alloy steel, so the high speed type of motor has had to wait for the perfection of valve mechanisms, lubrication and other vital features, before it could be considered a feasible proposition.

On the structural side of the problem there are four principal features which demand careful handling in the design and manufacture of this style of motor, as hinted at above: First, relative proportion of parts; second, valve mechanism; third, lubrication, and fourth, balance. Any one of these is fully as important as the other three, and whereas in the slow speed type if some of these conditions were not perfectly fulfilled it did not necessarily spell failure of the motor; in the case of the high speed type, it would mean utter impracticability.

The high speed automobile motor calls for a most exacting proportion of all component parts; a careful,

(*Concluded on page 37.*)

# The Storage and Handling of Gasoline in the Garage

## A Discussion of the Various Systems in Use

By Herbert T. Wade

THE chief aim in the construction of a garage should be to provide an absolutely fireproof structure, and this condition is insisted on more or less in municipal and insurance regulations. The modern concrete building has facilitated a fireproof garage in a marked degree, but distinction usually is made in official regulations between public and private garages, with naturally considerable leeway in construction for the latter. Given the garage, the storage of gasoline involves compliance with such requirements as those of the National Board of Fire Underwriters and municipal authorities, for it must be remembered that from the time the drums or barrels of gasoline are delivered at the garage it is a source of increased hazard to the premises and the surroundings.

The safety of property must be considered before any questions of convenience and expense to the garage owners; and while gasoline must be stored where it is subject to a minimum of loss by evaporation and where it can be supplied readily to the motor vehicle, yet it must be in such a place that the least possible danger will result from leakage or from the escape of vapor that may be reached by a chance flame or spark, not to mention the actual loss in fuel itself by evaporation, especially in summer, or with rapid fluctuations of temperature. There must be some pumping and piping system for its distribution, for insurance and fire regulations generally forbid the handling of gasoline in open containers.

Naturally there is the greatest safety when the gasoline is kept underground, and experience has shown that with a properly vented and otherwise protected storage tank underground adequate safety can be secured, irrespective of the size of the tank or the quantity of liquid contained. Tanks above ground are permitted by fire and insurance regulations only under special conditions and in rural districts. With the gasoline stored underground there is no danger from evaporation or leakage and consequently whatever troubles are encountered must be found in its handling, and here likewise it is necessary that suitable precautions be enforced.

To remove the liquid from a buried tank some form of pumping system is required, and this may vary from a simple hand-lift pump to a motor-driven pump or a system employing hydraulic or gas pressure. Naturally the pipes must be made tight by cement, impervious to the action of gasoline, properly protected, and so arranged that the filling hose or other outlet appliance is such as to present a minimum of risk.

The underground tank is made of galvanized sheet steel or wrought iron, riveted, welded or brazed, the material, thickness and other essentials complying with specifications prepared by the Underwriters' Laboratories or equivalent specifications of a local authority. Such a tank is buried below the ground at least three feet and may have separate fill and suction pipes and a vent pipe terminating some distance above the tank in a goose neck. The fill pipe when not in use must be capped properly and protected from access of air, being arranged so that it can be locked to prevent tampering, and it should extend to the bottom of the tank and contain one or more strainers of wire gauze, which also afford protection in case the flame should reach the fill pipe opening. The suction pipe, which must be at no point lower than the top of the tank to avoid explosion or gravity action in case of fire, naturally leads to the pump and may be supplied with various valves and strainers as may be required. The best forms of suction pumps deliver a steady stream of fluid through the hose to the car or to some form of portable receptacle, such as a bucket or safety can.

Wherever simple pumps are able to furnish adequate supply a hand pump is to. be preferred, even for a garage of considerable size, as the supply ceases when the attendant stops pumping. Such pumps are located in proximity to the place where the discharged supply is to be utilized and there may be a considerable length of line communicating with the underground tank. With such a pump and tank system it is found desirable to introduce a number of additional features so important as to be considered almost essential—for example, a device at the pump to drain back into the tank any surplus gasoline, and various straining and measuring appliances, the latter also recording the amount of gasoline actually delivered.

As the size of the installation is increased the pumping and distribution system naturally becomes more complicated, though essentially it is the same as in the simple installation, and if power pumping is introduced automatic devices usually are applied to stop the flow after a predetermined quantity has been delivered. In a large garage a measuring pump is essential, and these are supplied in various forms, with its cylinder carefully graduated so that each stroke of the piston delivers a fixed quantity of gasoline, the amount of which may be regulated by certain adjustments so that from one pint to five gallons may be delivered at a single stroke of the pump piston. The most complete pumps also have a meter registering the quantity of gasoline delivered, a filter and two-way nozzle, and a hose with portable nozzle for convenience in the operation of filling a car.

While the location and size of the tank may vary with local fire department or other regulations, whatever its size, the systems in general nature are essentially the same, and our illustration shows a gasoline supply station located at the curb with the storage tank buried under the sidewalk, though the general arrangement would apply equally to a large garage with a battery of tanks and a number of pumps. The arrangement shown with its red pedestal is familiar to traveling motorists. Such a tank is filled from drums or barrels or a tank wagon through a fill pipe reaching to the sidewalk, while its vent pipe extends to the side of the building and rises to a considerable height. These pumps must be constructed tightly fitting and of a design approved by the Underwriters' Laboratories, by whom they are labeled, and their accuracy should be carefully certified by local sealers of weights and measures.

A large public garage, where the gasoline is stored and handled by pumps, may be operated by a remote control system which can deliver the fluid from a storage tank, sometimes of as much as 11,000 gallons capacity. In one such type of installation a centrifugal pump connected to an electric motor is located at some convenient place within the suction distance of the storage tank. On the discharge line from the pump, which may extend up through several stories, one or more remote control, automatic, self-registering pipe line measures, equipped with oil separators, strainers, etc., are placed any distance from the pump convenient for using. The measure or measures are operated from a special electrical control equipment opened or closed either by hand by the attendant, or, if automatic appliances are introduced, the supply will be shut off automatically by the measure when the predetermined quantity has been recorded. This system has been elaborated so that several lines of hose may be connected with a single pipe line and by the use of an automatic control valve, so that a discharge end may be located at the curb for the use of tourists.

Although a mixture of gasoline vapor and air is highly explosive, yet so safe are these underground tanks when duly protected that at the time of the San Francisco fire one hundred and eighteen of the outfits of a single manufacturer installed in that city were found intact, and the inflammable fluid contained was pumped out and removed with a surprisingly small shrinkage from leakage and vaporization, not to mention complete protection from the fire. In one case a tank was found to contain over 200 gallons of gasoline after an interval of three years.

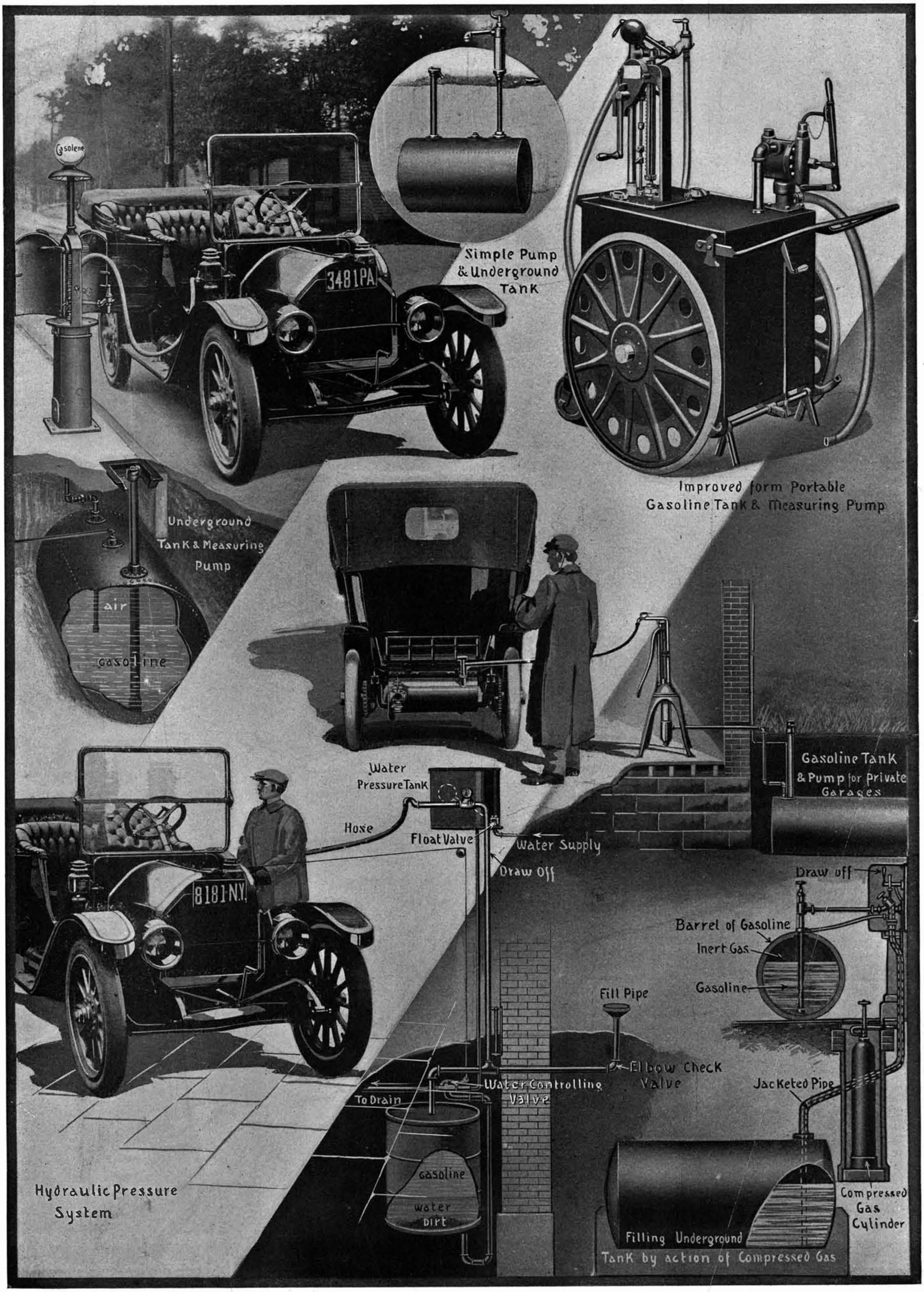
The distribution system based on the simple pump has the advantage of being complete in itself without connection with water, sewer system or compressed air, or requiring any outside material. It answers for installations of any size and the only essential is that there must be a supply of gasoline in the tank.

Mention here might be made of the familiar portable tanks where a number of cars, especially in garages or along the roadside, must be supplied with gasoline, and an elaborate system of piping is not desirable or feasible. In such an installation storage tanks are maintained with outlets and valves at convenient points, especially of the various floors of garages with several stories, and from them are filled portable wheeled tanks from which the gasoline is supplied through measuring pumps and hose with strainer nozzles to the individual cars as required, the portable tank being brought up to the car at its place of rest. The design of these tanks as well as the number is usually regulated by local insurance and fire regulations, tightness and stability being, of course, prime essentials, and as they can be moved by one man readily, they are convenient for transferring gasoline and reaching cars wherever they happen to be placed.

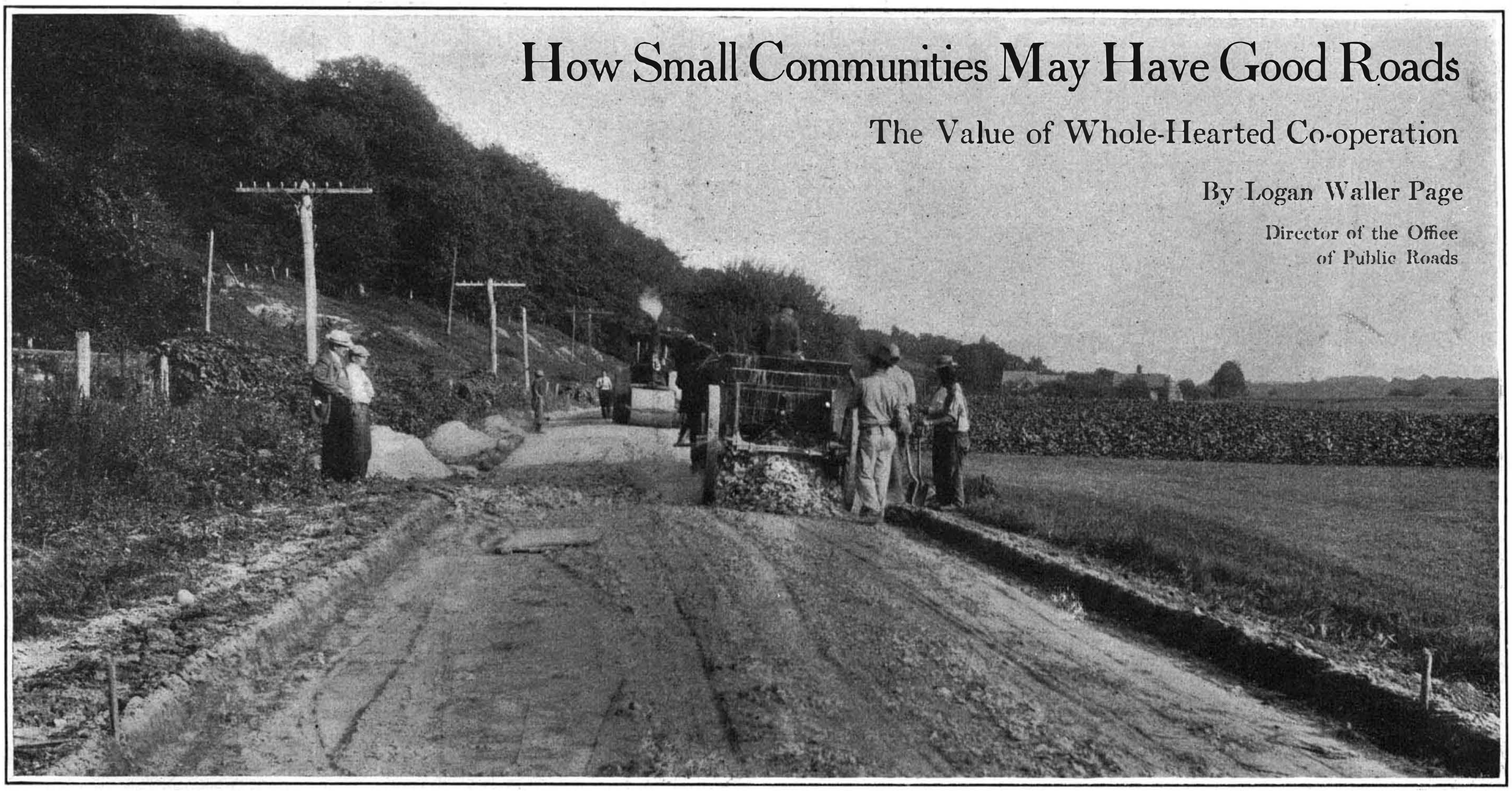
As contrasted with pumping systems where a simple air pump raises the gasoline, there must be considered the hydraulic system, where water pressure is the motive force. In these there is no air at all in contact with the surface of the gasoline, with the possible production of an explosive mixture, and the gasoline can be measured accurately both on admission to the tank and on being discharged, since in the latter case the liquid flowing through the meter is pure gasoline and not a mixture of air and gasoline or water and gasoline, which cannot be recorded satisfactorily. The hydraulic system is used in garages of all sizes, from the simple private installation to such a one as that of the American Express Company in New York with 500-gallon tanks having a capacity of 13,000 gallons. It acts on the following principle. The gasoline is contained in an underground storage tank which connects by a U-tube with a water pressure tank at such height as to furnish a proper pressure based on the difference between the specific gravity of water and gasoline and the distance to which the gasoline is to be delivered. This water tank is filled from the city mains and a float-cock maintains a constant level pressure. If water from the tank is admitted to the system by opening the three-way valve it will flow through the U-tube and into the gasoline tank, rising to an equal level in both arms of the U-tube. The gasoline on being discharged from the drum or barrel is admitted through the filling pipe and flowing down on top of the water in the supply tank causes the water below to be discharged through the drain at the water controlling valve on the water supply line. The gasoline stays on the surface of the water and the dirt settles to the lower part of the tank. On account of the lesser density of the gasoline a higher column will balance a lesser column of water in the proportion of 17 to 11, these figures representing the relative density of water and gasoline. When it is desired to draw off the gasoline this valve is opened, so that the pressure of the water in the tank acts on the gasoline in the storage tank, forcing it up through the draw-off pipe into the hose used for filling the tanks of the cars, a check valve preventing its return through the filler pipe. When sufficient gasoline has been passed into the tank of the motor vehicle or other receptacle the valve is closed, cutting off the water pressure from the pressure tank, and the normal condition of the liquid in both arms of the U-tube is restored. The amount of gasoline drawn off can be measured from a meter placed in the line of the draw-off pipe, and since the amount of gasoline supplied to the storage tank obviously must be equal to the amount of water displaced, which flows off through the drain, an accurate water meter can be installed in the pipe line to the drain to measure this quantity. Chief of the advantages is that the clean gasoline can be drawn off from the top of the tank and it is impossible for water or dirt to be drawn with it. There is no vent pipe open to the air or surface of gasoline in contact with gasoline. Furthermore, there is no air space, as the tank is always full of liquid, and hence no evaporation can take place or generation of explosive gases. The dirt and water at the bottom of the tank are forced into the drain when the tank is refilled. Like other systems which fill directly the main tank, no portable tanks are required, so that there is a minimum of fire risk. There is, of course, a waste of water through the drain, but the expense for this under ordinary circumstances is relatively small.

In addition to air lift and hydraulic systems, there have been employed extensively in Europe systems which use as head an inert gas such as nitrogen or carbon dioxide in contact with the surface of the gasoline, and carried in an annular space or jacket surrounding all pipes through which the inflammable liquid passes; as combustion is impossible in the presence of either of these gases their effect is obvious. The most notable of these systems, whose principle of operation is indicated in the illustration, was described in the SCIENTIFIC AMERICAN for July 18th, 1914. Its safety has been fully demonstrated not only in garages, but also in other establishments where large quantities of inflammable liquids are stored. It possesses the disadvantage of being dependent upon compressed gas supplied in cylinders to furnish pressure acting within the tanks. It is, however, thoroughly fireproof, and when well installed, as it has been in Europe, has supplied adequate protection and secured general official approval.

All of these systems have met with the approval of insurance authorities and where they are installed they are meeting the requirements. Care and maintenance enforced by insurance and official inspectors, however, are quite as essential as original installation, but the tendency toward uniformity and codification of local rules is bringing about a much more satisfactory and safer condition of affairs.




THE STORAGE AND HANDLING OF GASOLINE IN THE GARAGE



# How Small Communities May Have Good Roads

## The Value of Whole-Hearted Co-operation

By Logan Waller Page

Director of the Office of Public Roads

THE public roads in the United States, outside of incorporated towns and cities, have a total length of 2,228,042 miles, of which only 229,219 miles, or a trifle more than 10 per cent, are improved with any form of surfacing. Any means which promise to increase our small mileage of improved roads should, therefore, be given consideration and utilized to the fullest extent possible, with due regard for true economy and proper efficiency.

**Possibilities in Co-operation.**

The marked success of certain co-operative undertakings by farmers and rural communities, especially in the marketing and distribution of agricultural projects, has given the mere word "co-operation" a certain standing and distinction as indicative of the successful solution of all problems. But co-operation is to be judged from the results obtained. Certain forms of co-operation are efficient and successful, while others, even though seemingly successful, are extremely inefficient and entail a large waste of energy. For example, in certain sections, it has become popular to proclaim "Good Road" days, on which everybody is supposed to don overalls and labor on the roads. This is very commendable as a demonstration of interest and enthusiasm, but so far as securing adequate returns from the energy expended, it is far from ideal. It is, in fact, but a variation of the old system of statute labor, of which we have been trying so hard and so long to rid ourselves. The main distinction is, that in this case the labor is voluntary and made somewhat less onerous because of the hurrah and attendant advertisement. It sounds good to read in the papers of the eminent statesmen, bankers or men of business donning overalls and laboring with pick and shovel to mend our ways. This, no doubt, furnishes adequate compensation for the sore muscles and the few blisters, but how about the efficiency of this labor? If anything has ever been clearly demonstrated, it is the inefficiency of unskilled labor in road work. The time of the business man who cheerfully gives up his energy in more or less misdirected efforts to improve our roads can, on the average, probably be placed as worth at least the equivalent of five days of a common laborer, trained and efficient in doing this class of work. As unskilled labor is rarely more than 50 per cent efficient, it follows at once that this much advertised bit of altruistic endeavor, however, commendable from an idealistic point of view, is from the standpoint of economy only 10 per cent efficient.

**Economic Efficiency the Test.**

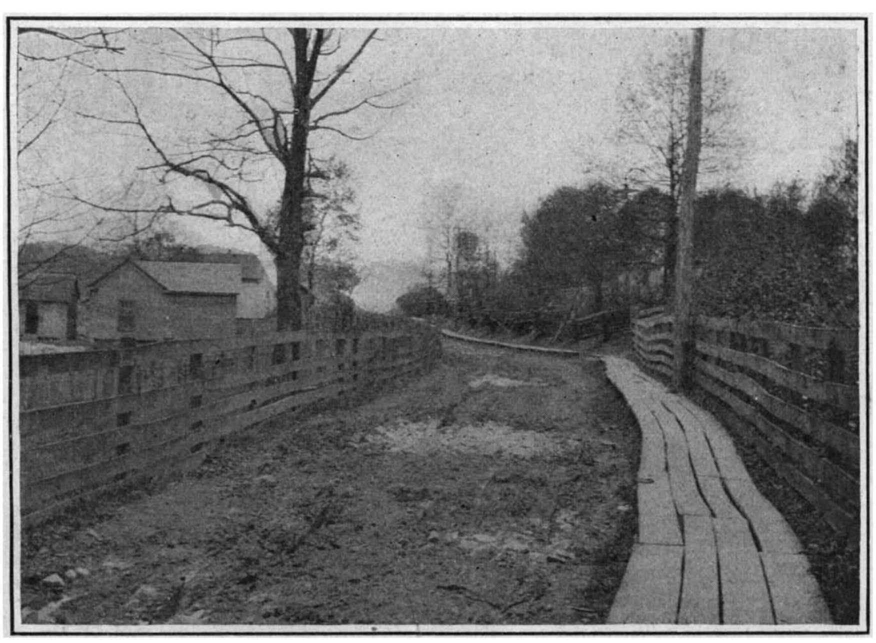
Co-operative as well as other public undertakings must ultimately stand or fall before the searching test of economic efficiency. Any co-operative undertaking, no matter how commendable its object, ought never to be tolerated, unless it is more efficient than the system it displaces. Our endeavor should constantly be directed toward a system which will ultimately yield us 100 per cent efficiency.

This does not means that co-operative undertakings have no place in our public road system. From the very beginning of road building in this country the roads were considered a local burden, in the construction and maintenance of which all should co-operate, each according to his ability. Where a road lay on the boundary of two towns, or other administrative subdivisions, legal channels were fixed, whereby both would co-operate in the construction and maintenance. Later, as the more general importance of our public roads began to be understood, legal channels were formed for such varied co-operation as the abutting property owners, the town, the county and the State. To-day, neither townships, counties, nor even State lines limit the general interest taken in the condition of our roads. The automobile and the motor truck have made the conditions of the roads of the country of direct interest to all. The automobile and the motor truck demand better and more permanent types of construction. Through routes or trunk-line roads have become a necessity in some localities. Certain branch roads and feeders are of only slightly less importance. From 60 to 75 per cent of our roads, however, still carry little or no through traffic, and so remain primarily of local importance.

**Trunk Lines and Branch Roads.**

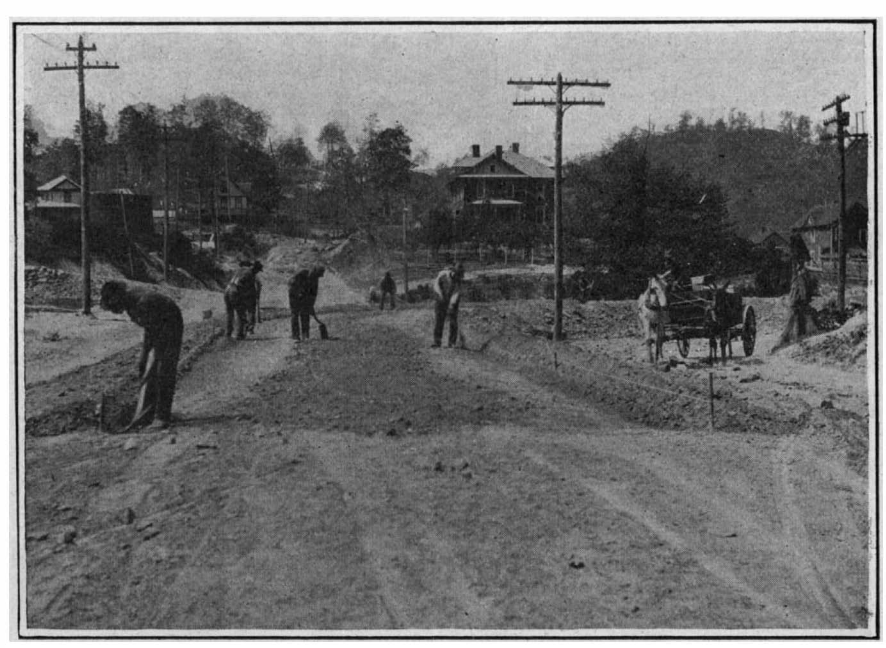
Most of our States have recognized these natural divisions of our public roads. No State has as yet, however, made this division on the purely scientific grounds of amount and kind of traffic carried, but several have made more or less happy attempts to secure the same results by utilizing, in general, our administrative units to make the several classifications. This has given us, in most States, a division into State or State-aid main roads, county roads, and town or township local roads. Massachusetts has only two subdivisions, State and town roads, while New York has four classes, State highways, county highways, county roads, and town roads.

While most of the States co-operate only directly in the construction of State or State-aid roads, a few have already realized the importance of directing local co-operation for the improvement of our minor roads. New York and Pennsylvania have established State bureaus of town highways, while Massachusetts has established



**Misdirected efforts.**

he energy required to fill the mudholes with boulders been expended in providing proper age and maintenance with a road drag, this might have been a good road.



**Properly directed efforts.**

A trained and properly organized labor force under efficient management can always be depended on to secure a dollar's worth of returns for every dollar expended.

**It takes more than enthusiasm and good intentions to make a good road.**

a somewhat similar division for aiding and co-operating in the improvement of town roads.

**Proper Planning, Management, and Funds Necessary.**

When our highway system is viewed from the broad standpoint of its efficiency as a public utility, it becomes evident at once that there are three fundamental requirements which must be fulfilled: First, a properly planned, classified, and laid out highway system; second, a proper and effective system of road management; and third, the provision of adequate funds. From a study of these fundamental requirements, it can be seen that undirected co-operation between local communities is apt to lead to costly mistakes. A small community is not likely to view the improvement from the larger interest of the county or State, and systems of efficient management and skilled labor are generally lacking. Furthermore, the town or township is frequently too small to form an efficient unit for road management and administration. The funds are too small to warrant the employment of a capable highway engineer and the purchase of modern road machinery. Certain forms of co-operation are, therefore, desirable in order to secure a large road fund, skilled supervision, and the use of efficient machinery. Vermont has solved this in part by the appointment of a county road supervisor, who co-operates with the town road officials, and so, in a way, helps to co-ordinate the road work of the entire county properly. New York and Pennsylvania have established bureaus of town highways which direct and guide, to a large extent, the road work of the several towns throughout the State. The work is thus systematized, plans are standardized, and there is co-operation along definite and well directed lines.

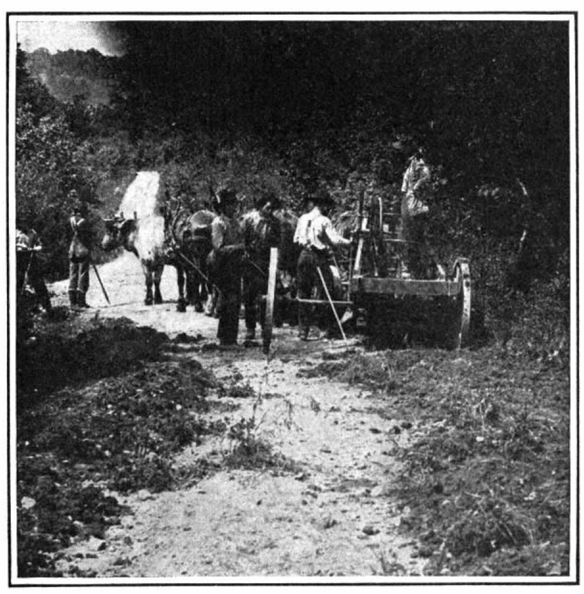
**Various State Systems.**

Other States have nearly the same system, but with a county unit instead of a State bureau. But, as the county organization is more or less subordinate and responsible to the State Highway Department, the distinction is one of degree, rather than of kind. Some of the more important examples of this system are Iowa, Illinois, Wisconsin, and Minnesota. While there are many dissimilarities in the highway organization of these States, there is one fundamental and striking similarity, the effort to secure reasonable co-operation throughout the various units, and, at the same time, provide a fixed, definite responsibility for all actions. Other States, such as California and Montana, do not use the township organization in their road work. The county is the unit, which may, however, be subdivided into districts according to the will of the Board of County Supervisors. The tendency here, however, is very strong against the old method of subdivision, and in favor of a county unit with a capable engineer in charge of the road work.

This explains why many of our States are formulating means for directing the work of the local communities. The most conspicuous examples of co-operation are to be found in such States as have a State Highway Department or Bureau, especially provided for giving efficient guidance and direction to work of this character. Under these conditions and with the above limitations clearly understood, co-operation between local communities in road building may be carried on with considerable success.

**Preparatory Steps.**

In making preparations for co-operation of this kind, the first point to be considered is that all our public roads are by law under the jurisdiction of one or more public officials. Before any definite work can be done, it is necessary to secure the consent of the officials having charge of the road to be improved, or what is far better, to secure their co-operation and support. The second step is to secure competent advice in regard to the improvement to be made. It would be extremely unwise, for example, to place a macadam or bituminous surfacing on a road where gravel or sand-clay would answer all the requirements. It would also be a waste of money and labor to reduce a grade to 1 per cent where a 3 per cent grade would answer as well. On the other hand, it would be just as much folly to place a gravel or sand-clay surfacing where traffic requirements demanded bituminous construction, or its equivalent, or to leave a grade 7 per cent where traffic demanded a 3 per cent grade. In other words, over-investment and underinvestment are both bad. Both lead



**Working out the road tax.**

to loss of time and labor and money. The aid of a little really expert advice when the work is being planned will save the community much loss and needless worry. The second point may, therefore, be restated thus: Get competent advice as to what to do, and then follow it!

The third step deals with the actual construction of the road. This usually requires funds, labor, materials and the use of more or less machinery. In securing these there is room for the exercise of any amount of genius and ability. The one essential requirement is

**Road near Bowling Green, Kentucky, built by co-operation of the county and local farmers.**

to secure the maximum efficiency from the expenditure of the funds and labor.

**Example of Methods.**

As an example of the great diversity of ways and means that may be employed in getting work done, the following cases may be cited: Nearing Bowling Green, Kentucky, the main market roads had been macadamized by the county. The local roads, however, were unimproved. A number of farmers decided to improve these branch roads, over which they had to pass in order to reach the main roads. During the plowing season all the rocks encountered in the fields were picked up and thrown in piles. Later, when the crops were in, and time available, these stones were hauled to the county rock crusher. County co-operation had been secured to the extent of furnishing and operating a crushing plant and a road roller. The farmers then hauled the broken stone and placed it on the roads. The actual cash outlay of the county for the crushing and rolling was at the rate of $500 per mile for roads ordinarily costing $3,000 per mile. The farmers, moreover, secured good roads and cleared their fields of stone at the same time.

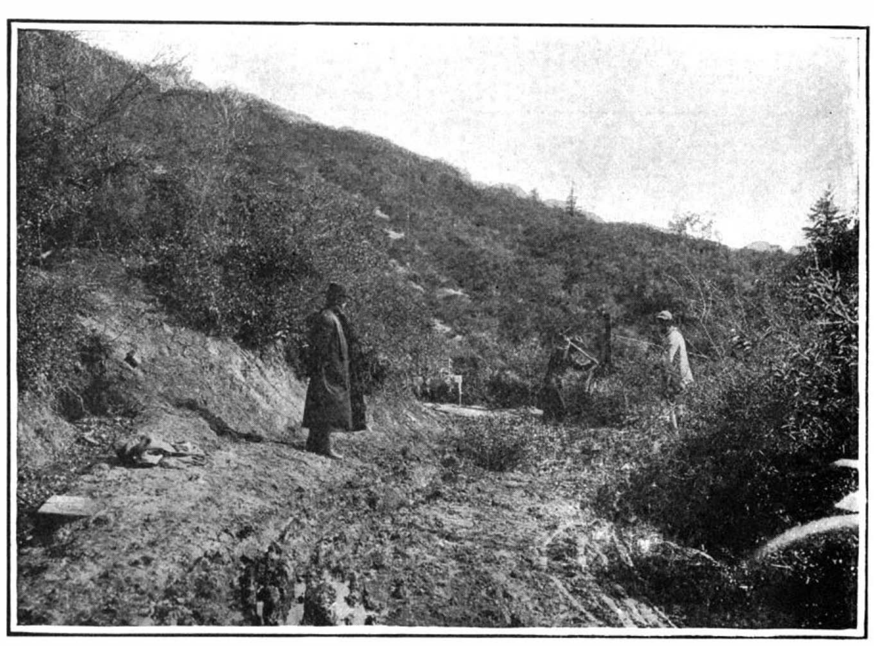
An example of civic pride, rarely equalled, was shown in the little village of Friendship Heights, Maryland. When the Rockville pike, which passes through this place, was being resurfaced, it was proposed to use a somewhat cheaper surfacing through the village, because of lack of funds. The ladies of Friendship Heights, however, would not be satisfied with any surfacing which was not equal to the best to be found on the road. From the engineer in charge of the work on the road they ascertained the amount necessary to supply the deficiency, and at once set about to raise the funds by holding a bazaar. It is needless to say that the money was duly raised, and, thanks to the ladies, the village of Friendship Heights has as fine a road as any part of the Rockville pike.

**A Commercial Club Assists.**

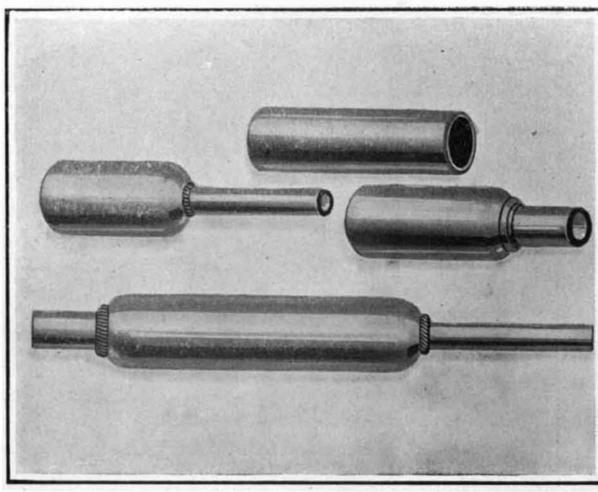
In Hartington, Nebraska, the Commercial Club became convinced that one of the greatest needs of the region was good roads. During a considerable portion of the year some of the roads leading to the town became so bad that farmers were unable to come to town except on foot or horseback. There were thus long periods of dullness and little or no business. An agreement was finally reached by the Board of Supervisors,

*(Concluded on page 38.)*

**The engineer making the layout of what is intended to be a properly planned and constructed road.**

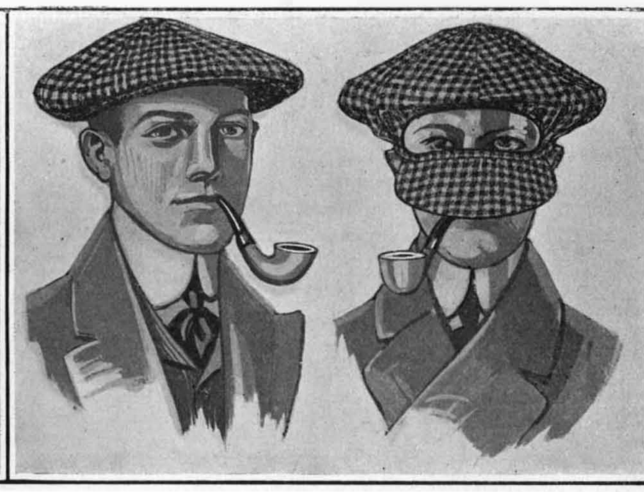


**Enthusiasm and misdirected labor a poor substitute for trained labor and skilled supervision.**



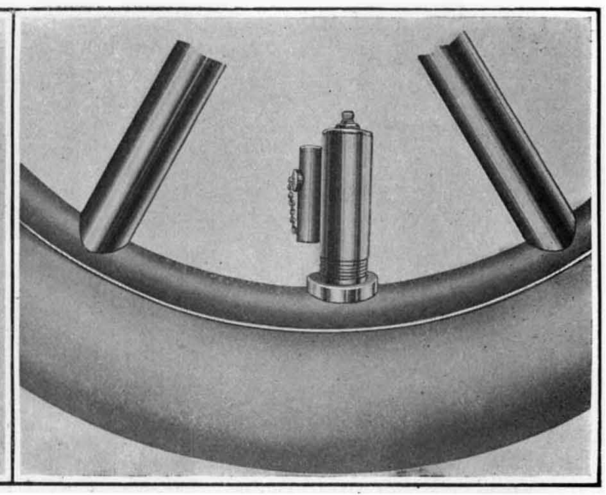
**Sanitary drinking tube.**

A compact quill-like device, made of aluminium, and containing a bone charcoal filter. When the two end parts are withdrawn from the cylinder and placed with the smaller tubes projecting outward a combination "drinking straw" and filter is formed, that lessens the danger and adds to the comfort of drinking from wayside streams.



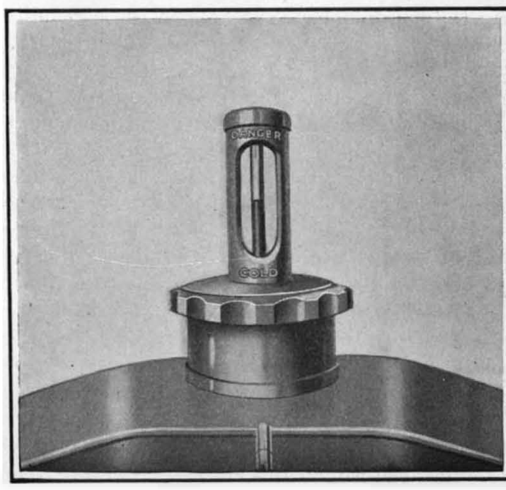
**A universal cap.**

This has a tinted celluloid window that ordinarily folds up out of sight in the crown, but if you run into a cloud of dust, bugs, cinders, or driving rain, with one hand the visor and window can be instantly pulled down to protect the face and eyes, while the sight is not interfered with in the least. The cap is made in a great variety of patterns for both men and women.



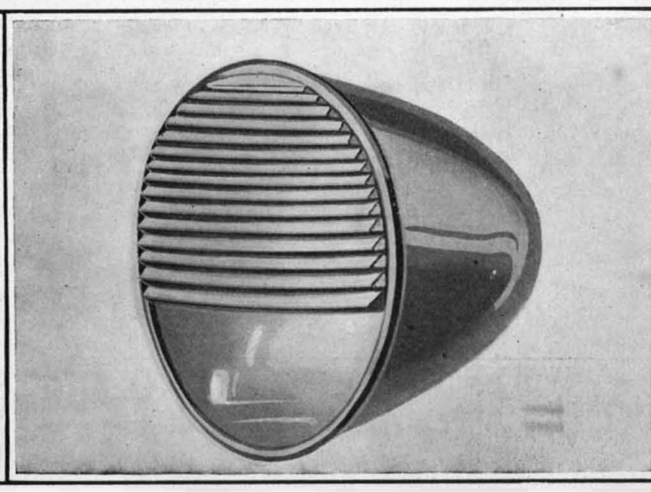
**Low-pressure tire alarm.**

A cylindrical device intended to be attached to the valve stem and provided with a whistle, which is automatically set in action as soon as the air pressure in the tire to which the alarm is attached, falls below a certain predetermined amount. A valve in the alarm enables the signal to be turned off if it is necessary to drive farther with the deflated tire before repairs can be made.



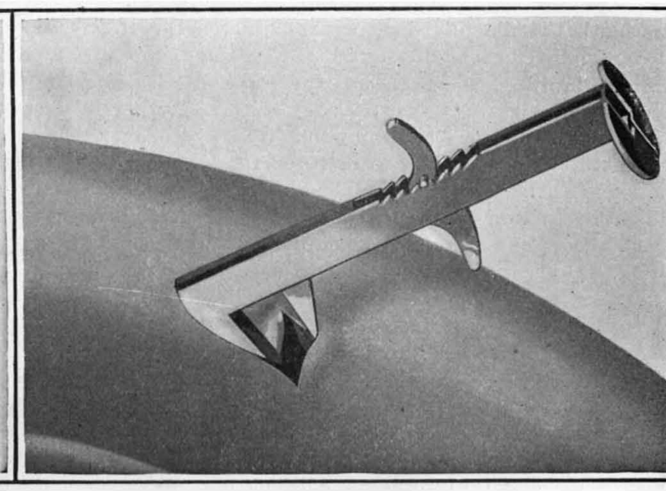
**A check on overheating.**

A long-stemmed thermometer, inclosed in a glass and nickel cylinder to insert in the radiator cap, so that the temperature of the cooling water may be seen by the driver without leaving his seat. The stem is of such length as to remain always in the water.



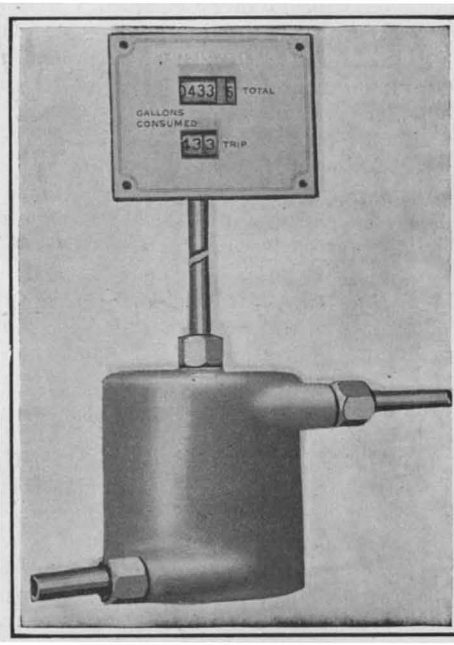
**Deflector headlight glasses.**

A headlight glass provided with horizontal corrugations in its upper half, constituting prismatic lenses. These prisms collect the greater part of the light, and direct it downward and forward, increasing the illumination of the road; but allow enough diffused light to pass directly, to constitute a warning to those in front, without dazzling their eyes.



**A tire repair tool**

An ingenious tool, consisting of one fixed and one movable jaw, the latter operated by means of two finger triggers acting in notches cut in the upper edge of the shank. By drawing on one trigger the space between the jaws is widened and a cut in a tire or tube may be spread apart and held in place while the cut is cleaned. A pressure on the other trigger releases the movable jaw.

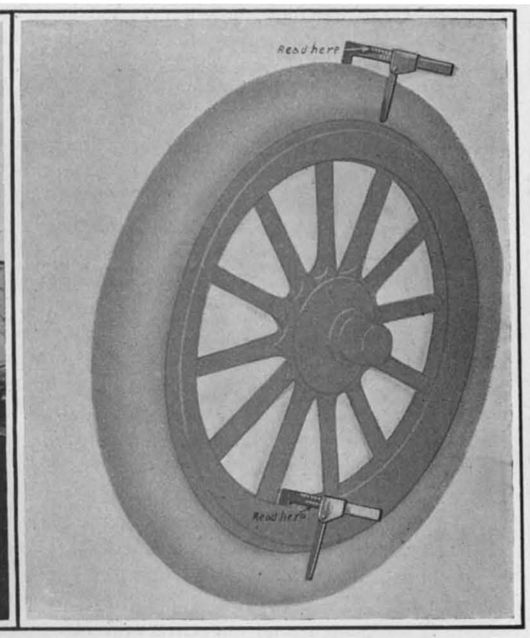


**Measuring the fuel.**

This is a compact meter to place on the dash that will accurately measure the fuel consumed, regardless of speed of flow or pressure. This enables the owner to check expense and waste.

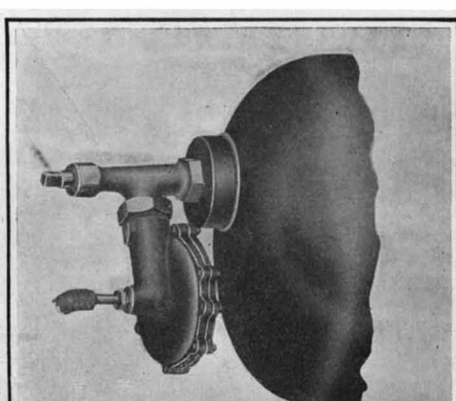
**A comfortable auto robe.**

This heavy, woolen lap robe is provided with pockets in the bottom for protecting the feet of the occupants of the tonneau; and by means of properly arranged snaps the upper portion of the robe, which is in the form of an apron, can be drawn closely around the throats and shoulders of the occupants. This is made in both single and double widths, the latter having two pairs of foot pockets and two aprons.



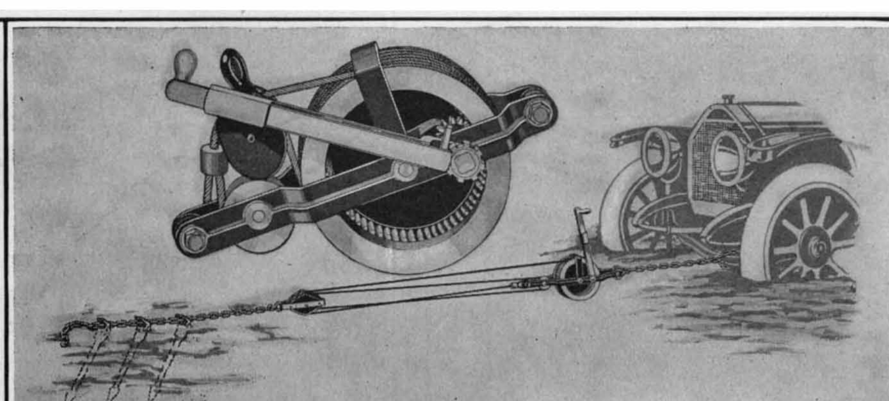
**Tire caliper.**

This instrument determines the amount of flattening of the tire at its point of contact with the road. The scales give the comparative diameter of the tire at point of greatest load, and at the point diametrically opposite.



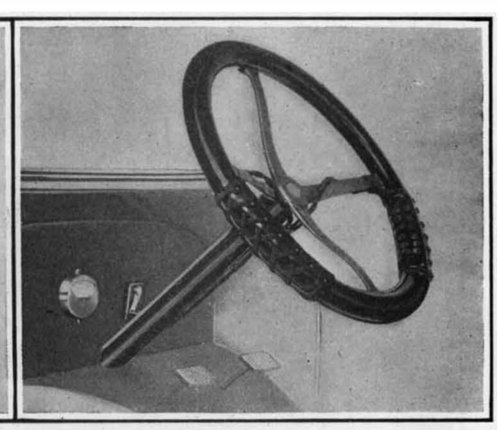
**Pressure-reducing valve.**

This is attached to an acetylene gas tank and furnishes the gas at a constant pressure to the burners, regardless of the tank pressure. The gas valve may be opened wide without the danger of a high flame at the lamps.



**A rescue windlass.**

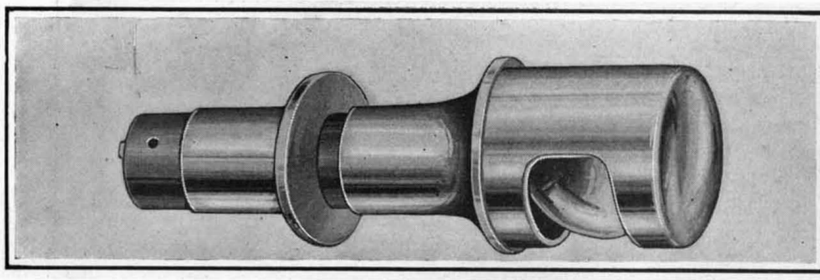
This has an internally geared drum that is operated by a small pinion and a crank handle. The single block of a two-block tackle is combined with the winch. The fall of this tackle is wound on the drum, and this winch gear and tackle give a pull powerful enough to extricate an automobile from a mud hole, ditch, or other inconvenient position. The windlass is made fast to the axle of the automobile, and the double block of the tackle is anchored with stakes that will hold in almost any ground.



**Warm wheel grips.**

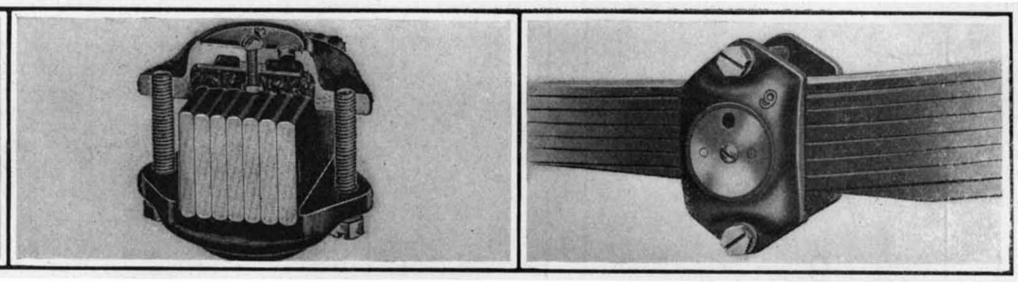
These are electrically heated leather grips that are simply laced upon the steering wheel rim. They are operated either from a battery, lighting system, or generator, and require but little current. They insure warm hands, which helps avoid accidents.

NEW IDEAS IN AUTOMOBILE ACCESSORIES



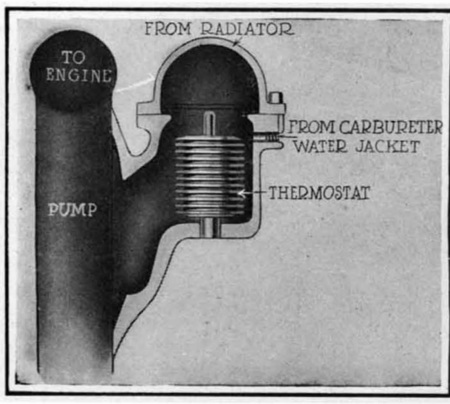
**Combination dash and trouble lamp.**

A "bayonet" socket in which an easily removed dash lamp may be placed. This furnishes a receptacle for one terminal of a long, flexible cord, into the other end of which the dash lamp may be inserted, thus forming a most convenient trouble lamp that will throw its rays to any desired part of the car. The shade on the dash lamp serves as a reflector for the rays of the trouble lamp.



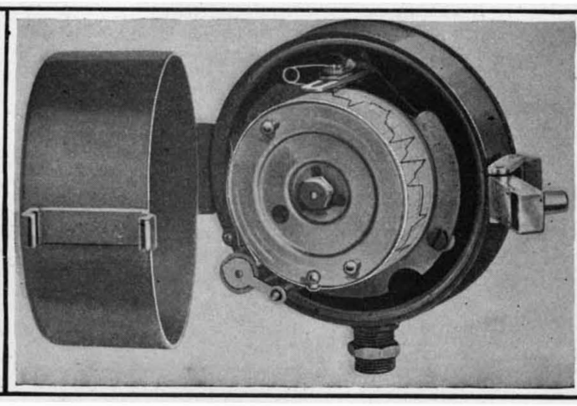
**Lubricator for leaf springs.**

A box-like device intended to be clamped to the sides of leaf springs to furnish lubrication for the surface. Squares of felt that line the sides of the box and that are pressed against the leaves of the spring serve as oil reservoirs from which the oil creeps by capillary attraction between the constantly moving surfaces of the leaves of the spring. The sectional view shows the construction clearly. The device may be applied with an ordinary screw-driver.



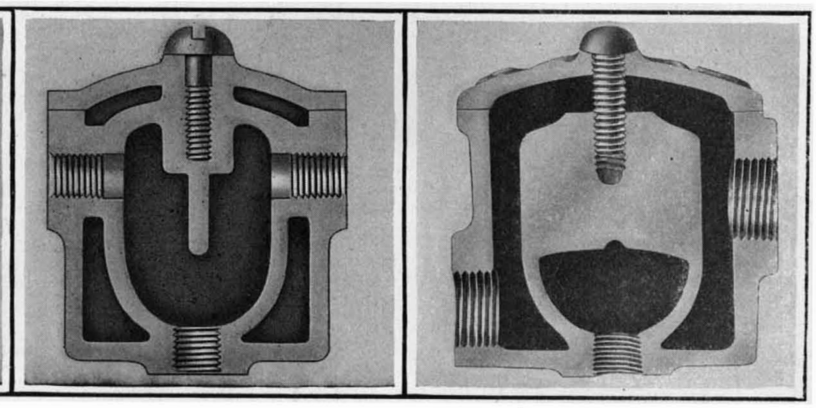

**Thermostatic cooling-water regulator.**

A valve actuating device controlled by the temperature of the jacket water. When the motor is first started the valve is closed; as the water becomes heated the thermostat expands and allows the passage or more water through the jackets.



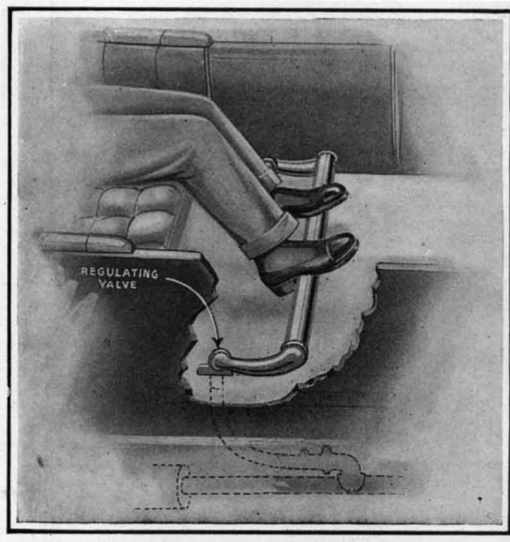
**Log book for the motor vehicle.**

An instrument which records time, distance, speed, and stops. It is adapted for motor trucks, to provide an absolute check at all times over the vehicle. The instrument has a star type of transmission, and is secured to the front wheel. Special means of attachment under the apparatus makes it tamper-proof.



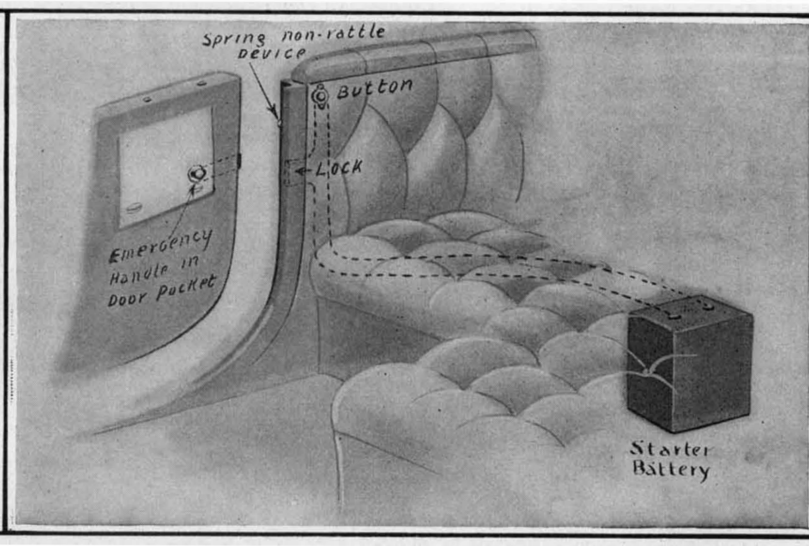
**Fuel preheater connected with the exhaust.**

A device intended to be installed in the fuel pipe near the carbureter, for preheating the fuel before its entrance to the float chamber. This device consists of an inner chamber, which is jacketed and surrounded by the exhaust gas. Thus the liquid fuel, rather than the atomized mixture, is heated, and the gasoline consequently changes to a gas the instant it is ejected through the needle valve. The two sectional views shown are taken at right angles to each other.



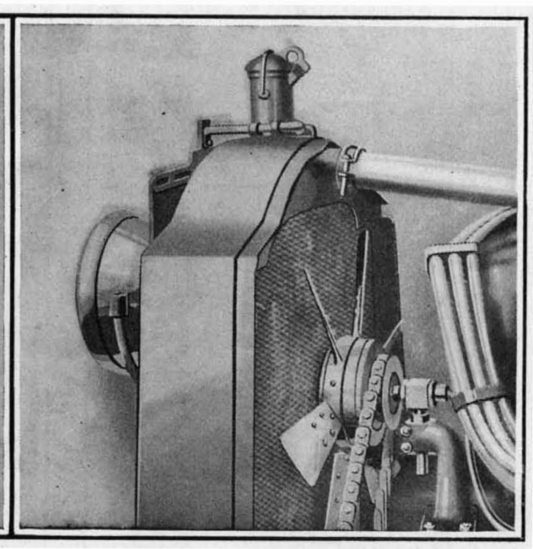

**Ingenious foot warmer.**

A hollow tube, similar to the foot-rail found in the tonneau of touring cars, is connected, by means of flexible piping, with the exhaust pipe of the car. A valve enables the occupants of the tonneau to admit the hot gases through the foot-rail, or to deflect them through the muffler.



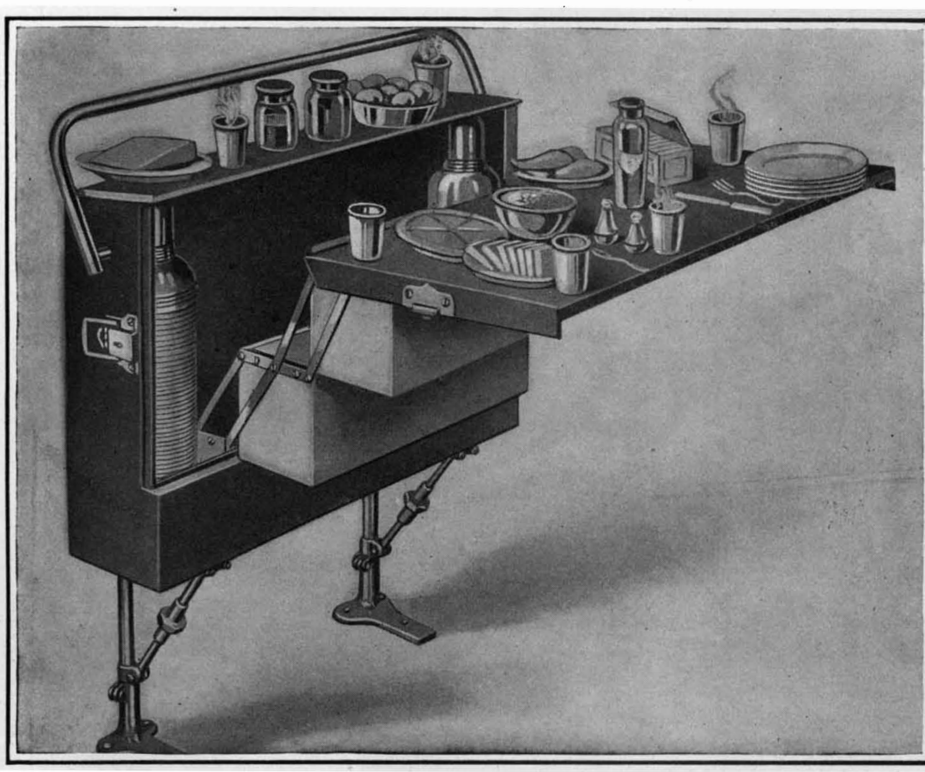

**Electric door latch.**

One of the recently designed light cars is provided with electric latches at each door. These are controlled by means of magnets excited by the storage battery used in the starting and lighting system of the car. The latches are held in place by springs and are released by the pressure of a button located in the side of the body, close to each door. A handle in the pocket on the door may be used in case of emergency.



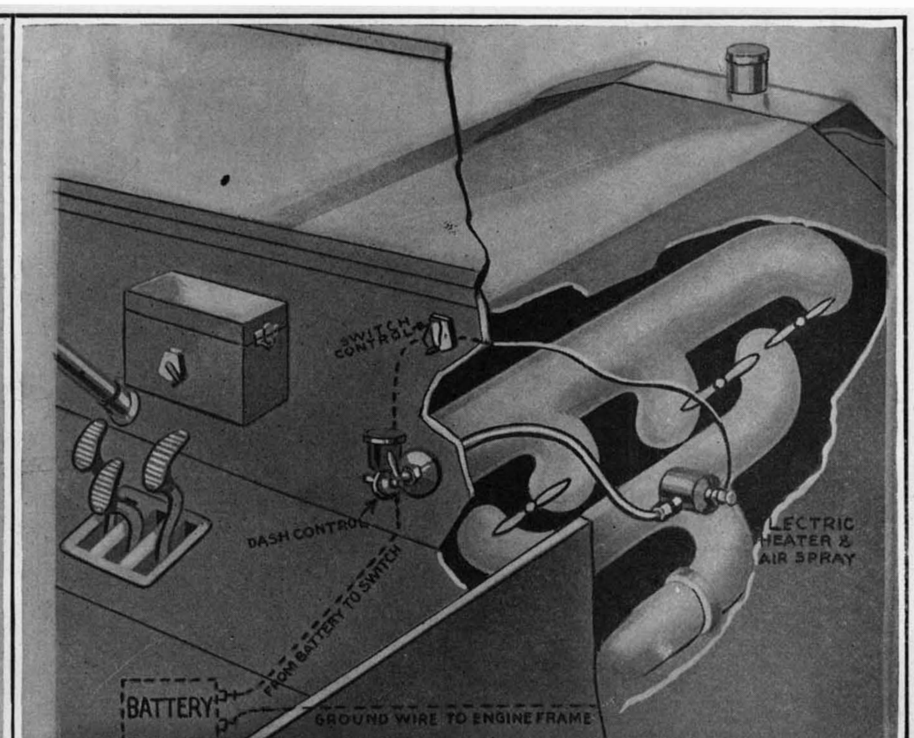
**Combined fan and electric generator.**

An electric generator combined in the hub of a radiator cooling fan. One portion of the hub serves as a stationary armature, while the revolving fields are carried by the fan. This generates direct current that may be used for charging batteries, for lighting and for ignition.



**Motor lunch-case and table.**

A compact lunch-case, not much larger than a suit-case, which may be attached to the motor car. When opened the front of the case forms a table on which the lunch may be served. Within the case are a vacuum bottle, and two compartments in which food may be kept ice cold or steaming hot for twenty-four hours. The case holds an ample lunch for six persons with all necessary table appointments.




**Electric primer and vaporizer.**

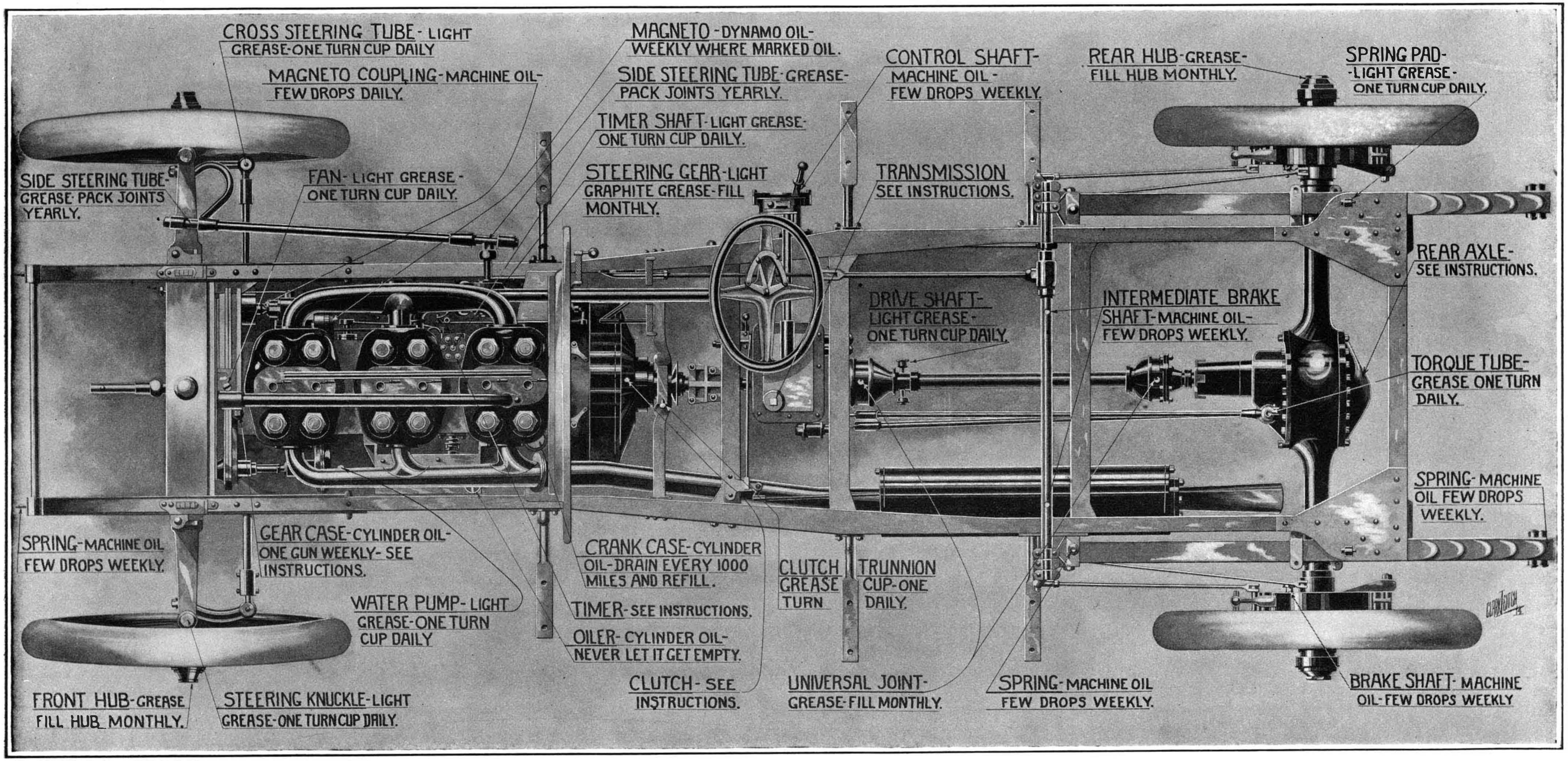
From the priming cup on the dashboard a copper tube leads to a plug connected to a battery and inserted in the intake manifold of the engine. The gasoline from the priming cup passes through the plug, and it is not only sprayed, but actually boiled and vaporized, so that when the engine is cranked over it starts on the first turn over, just as easily on a cold winter morning as on a summer day.

**NEW IDEAS IN AUTOMOBILE ACCESSORIES**

# Chart Illustrating the Proper Lubrication of the Standard Motor Car Chassis

## Instructions for the Systematic Oiling of All Important Parts of the Automobile Mechanism

Arranged by Victor W. Page, M. E., Author of "The Modern Gasoline Automobile"



## Lubrication of the Motorcar Chassis*

### Explanation of Chart

THE plan view of a typical six-cylinder automobile chassis is depicted in the accompanying plate with all important bearing points requiring lubrication outlined. The construction of this chassis follows regular practice and it should be valuable as a guide to the correct lubrication of any car of modern design. While the arrangement of components will vary in the different car types, most of the points indicated will be found in all automobiles and the directions given can be followed to advantage in caring for types other than that shown.

The importance of proper lubrication cannot be impressed too strongly on the minds of the average motorist or chauffeur. Any neglect in this essential means rapid depreciation of the machinery. Attention should be given to all minor points of the chassis periodically as lack of oil at what are usually considered points of minor importance means wear at a multiplicity of joints and noisy operation of the car even if the power plant, gearset, and rear axle are functioning perfectly. In the following instructions, endeavor is made to treat the subject in a concise manner, giving the best kind of lubricant for the various bearing points, reasons for its use, and best methods of application. Where the parts of different design require special grades of oil, this point is noted and proper grade recommended.

### Engine Lubrication.

The best grade of oil to be used in the automobile engine depends upon a number of factors, such as power-plant type and condition, lubricating system used, and climatic conditions. The essential point to be observed is to select an oil of sufficient body and fire test to produce a film between all friction surfaces even when the parts become heated. The degree of fluidity must be suited to the system of supplying the oil to the working parts employed. Lighter bodied oil is needed in winter than in summer. The degree of wear between engine parts also governs oil selection to a degree, as a worn engine requires heavier bodied oil than one in which the bearing parts fit more closely together.

The proper oil for the lubricating system shown, which consists of a mechanical force feed oiler at the side of the engine crankcase with exposed pipes, must have a low cold test, that is, it must remain fluid at very low temperatures. In the systems where the oil supply is carried in a sump integral with engine crankcase and without sight feed glasses or exposed pipes, the lubricant need not be of low cold test, because all parts of the engine become heated enough to promote positive circulation of oil soon after the engine starts.

The use of too much oil will result in carbon deposits in cylinders and will be evidenced by clouds of white or gray smoke from the exhaust pipe when the engine is raced. Not enough oil will produce overheating, as will oil that has not enough body. If an engine that has been run for a time is noisy, try a heavier oil if a light bodied oil has been used regularly. Air cooled engines require a heavier bodied oil than water cooled types do because they run hotter.

The following specification for light cylinder oil is recommended by the S. A. E.

Oil must be pure mineral oil, no addition or adulterant of any kind being permitted. The following characteristics are desired:

| | |
|---|---|
| Specific gravity | 28° to 32° Baumé |
| Flash point, not less than... | 400° F. |
| Fire test, not less than...... | 450° F. |
| Carbon residue, not over | 0.50% (½ of 1%) |
| Viscosity, at 100° F. Saybolt. | 300 seconds |
| Viscosity, at 210° F. Saybolt. | 50 seconds |

Use only cylinder oils recommended by the car maker or reputable manufacturer of lubricants. For new engines, oil of medium grade in body and clear, pale amber color will be found suitable.

Besides the cylinders and interior parts, there are a number of other points about an engine needing oiling. When the timing gears are housed in a casing distinct from the crankcase care should be taken to keep the supply uniform in this case as well. About one pint of oil will be enough, and cylinder oil of heavy body should be used. The starting crank bracket bearing should be oiled with an oil can, the pump shaft by screwing down the grease cups on the bearings. Mutton tallow and graphite are the best lubricants for this purpose. The fan bearings are usually of the ball type and the fan hub can be packed with light cup grease or vaseline at the beginning of each season.

### Electrical Apparatus.

Special care is needed in oiling electrical apparatus. Only light spindle or sewing machine oil should be employed and then in small quantities. The timer, if of the platinum contact point type, needs lubrication only at the bearing points. If a roller contact type, use sewing machine oil sparingly in timer interior. Never use grease or graphite; the latter short-circuits the current, the former gums up and interferes with good contact between roller and segments. Avoid the use of machine or cylinder oil in magneto, generator, and starting motor bearings; use only light oil and a few drops at a time. If these bearings are oiled too frequently, the windings on armature may become oil soaked. This will result in short-circuiting. Avoid the use of oil in magneto contact breaker or distributor; these parts are intended to run without oil.

### Clutch Lubrication.

A cone clutch requires lubrication only at three points, these are the spigot bearing, the ball thrust, and the clutch release yoke or rolls. The spigot and ball thrust bearings are usually supplied with light grease through a grease cup. The release yoke and rolls are nearly always oiled by hand, using an oil can and machine oil. The cone clutch leather must be kept pliable with neats-foot or castor oil; never use cylinder oil for this purpose. Oil accumulations on the clutch leather will cause slipping; these must be washed off with kerosene or absorbed with borax or fuller's earth.

Three and five plate clutches operate practically the same as a cone clutch and are intended to be run dry except for the points noted above. Multiple-disk clutches having the driving members faced with asbestos friction fabric are also intended to operate without oil between the friction surfaces.

Multiple-disk clutches using all metal plates are usually inclosed in an oil retaining casing. These are intended to run in an oil bath. Clutches of this pattern are usually lubricated by putting in oil through a filling plug, enough being used to almost touch the center shaft. A good lubricant for most disk clutches is a half and half mixture of light cylinder oil and kerosene. Special lubricant of the proper body for disk clutch oiling may be obtained on the open market.

### Change Speed Gear Lubrication.

The most commonly used form of change speed gearing is the sliding gear type. The case is filled about half full with a semi-fluid grease or very heavy bodied steam engine cylinder oil. Avoid heavy greases; these will not properly lubricate the bearings and the revolving gears will cut channels in the grease so that none will get between the teeth. The grease must be light enough to be churned about by the gears. Do not use greases filled with wood fibers or granulated cork. These will cause rapid depreciation of bearings.

Planetary gearsets are seldom used on modern cars. That on the Ford is oiled by the lubricant employed in the engine interior and operates in an oil bath. Where the gearing is carried in a separate case, as in old type cars, use a very light semi-fluid grease, introducing the same with a syringe or oil gun through suitable filling openings normally closed by removable plugs.

Change speed gearing of the positive sliding clutch types with gears always in mesh, or those of the same pattern employing silent chains can be oiled by the same grease used in sliding gearsets. Friction disk forms use grease only at bearing points; no oil should be allowed to accumulate on the driving surfaces.

### Rear Axle Lubrication.

The differential gearing of most axle types is housed in a casing that will retain oil. Where bevel gearing is used a grease of about the same grade as that advised for sliding gears may be introduced through a filling hole. Where worm gearing is used the grease should be more fluid; it should be practically a heavy oil, especially if the worm is mounted above the worm gear. This is an important point to observe, as the oil must be lifted by the worm gear teeth to the worm and its supporting bearings.

Many commercial vehicles use chains for driving from a jackshaft to rear wheels revolving on a fixed axle. Chains must be oiled frequently and with care. The points subject to wear are the roll bearing and the link joint rivets. The best method to insure thorough lubricity of these points is to remove the chains from the sprockets, wash them thoroughly in gasoline or kerosene to remove all grit, and then to immerse them in a mixture of molten tallow and graphite. Hang up the chains, allow them to drain off, and then wipe off all surplus lubricant from the chain surface while that member is still hot. This process insures thorough penetration to the bearing points. Oiling the chain surface with an oil can is not sufficient, as this surface oil only collects grit.

All shaft drive cars use one or two universal joints, depending on the method of housing the pinion driving shaft. If this is carried in a torque tube but one joint is used, that at the upper end. Universal joints are usually encased and this casing may be filled with very light grease. On old pattern cars using open joints, leather bags should be made to lace around the joints, these being filled with light grease. These covers serve the dual purpose of protecting the joint from grit and retain the lubricant as well.

### Miscellaneous Chassis Points.

*Wheel Bearings.*—The anti-friction bearings used in both front and rear wheels are intended to be packed with light grease and if the supply in the wheel hubs is renewed several time each season no trouble will be experienced at this point. Axle bearings of the roller type are usually greased by small compression grease cups on the housing, as are torque tube bearings.

*Springs.*—The main points to lubricate on the suspension members are the spring shackle bolts. These are oiled with machine oil if provided with oil cups and with grease if compression cups are fitted. The spring seats on some rear axles are also fitted with cups to receive lubricants if these members are intended to oscillate on the axle housings. Every season the springs should be taken apart, all rust removed from between the leaves and light grease and graphite smeared between the leaves when the springs are reassembled.

*Steering Gear.*—The housing at the lower end of the column is usually provided with a filling plug through which cup grease may be introduced until gear housing is full. A grease cup is often provided through which additional lubricant may be introduced. Oil must be squirted in between the column tube and steering post periodically, also on the spark and throttle control members if these pass through the steering post center. The ball joints on drag link and yoke bearings on the tie bar must be kept oiled or greased as the case may be. The compression cups on the steering knuckle bolts must also be screwed down periodically.

*Control Members.*—The hand levers for shifting gears and applying the emergency brakes and the clutch and brake pedals are located on concentric shafts in some cars and these shaft bearings must be oiled by a hand oil can in most cases. The small rod end pins on brake rods and bearings on the axle supporting the brake control shafts also demand frequent attention with the hand oil can.

*Draining Off Used Lubricant.*—As any oil or grease is used, it gradually depreciates in value as a lubricant. The oil used in constant level splash systems of engine lubrication becomes impregnated with carbonaceous matter and metal dust due to attrition of the bearings and other internal parts. That used in gearsets may contain small metal particles chipped off of the gears when these are clashed in shifting and the oil in the differential housing also becomes dirty as used. In other words, oil may "wear out" and become unsuitable as a lubricant when used continuously. Most engine builders recommend thoroughly draining out the engine crankcase every 1,000 miles, washing out all sediment with kerosene, and replenishing the supply with clean, new oil. The smallest automobile engine crankcase will need about a gallon to refill, those of larger engines may require two or three gallons.

A multiple-disk clutch case should be cleaned out frequently, usually as often as the engine receives attention. Gearboxes and rear axles should be washed out every 2,000 miles and new clean lubricant used in refilling. Where grease cups are employed the new grease forces out the old lubricant, as the cup is screwed down so a constant supply of clean grease is insured. Similarly, those points lubricated with fluid oils are supplied with clean oil from the hand oil can as the used oil leaks out gradually from between the surfaces. Keep all surfaces exposed to the dust wiped clean of lubricant, as this serves no useful purpose, merely attracting road grit. Keep all oil and grease from the tires, rubber hose connections of the cooling system and insulation of the ignition wires, because lubricants have a soluble action on rubber or compounds containing that material.

* Copyright, 1914, by the Norman W. Henley Pub. Co.

## Preserve Your Papers: They Are of Permanent Value

BY taking a little trouble, when a paper first comes to hand, it may be preserved to form a permanent and valuable addition to the reading matter with which everyone should be supplied. We furnish a neat and attractive cloth board binder, which will be sent by mail, prepaid, for $1.50. It has good strong covers, on which the name SCIENTIFIC AMERICAN or SCIENTIFIC AMERICAN SUPPLEMENT is stamped in gold, and means by which the numbers may be securely held as in a bound book. One binder may thus be made serviceable for several years, and when the successive volumes, as they are completed, are bound in permanent form, the subscriber ultimately finds himself, for a moderate cost, in possession of a most valuable addition to any library, embracing a wide variety of scientific and general information, and timely and original illustrations. Save your papers.

**The Zodiacal Light.**—According to Fessenkoff, it is impossible, in view of the discordances existing between the facts announced by different observers (Bayldon, Marchand, Tupman) to fix in any precise manner the position of the band of zodiacal light. New observations are necessary and Birkeland proposes to pursue them for a period of three years at Natal and elsewhere, including Uganda. His object is to test his hypothesis relative to the emission of radiant matter and electrons by the sun. In his opinion these corpuscles group themselves around the sun's magnetic equator.

# War Experiences of an Air Scout—II*

## The Patrol of the Sky

By Frederick C. Hild, American Volunteer With the French Aviation Corps

THE next morning a bugle aroused us at 6:30, and after a hasty toilet in a cold stream that runs close by I was ready for roll call. This roll call is held at 7 o'clock every morning, and as absence from this means four days in jail I always managed to be present. Saluting superior officers was another hardship, and after several "call-downs" I was able finally to salute every officer I met as well as the two-year experienced and trained soldier.

After roll call we went to breakfast. This consisted of a cup of black coffee and hard dry bread. How the French government expects us to fly on such fare is beyond me. I went to the home of some peasants in the vicinity, and for a few cents I obtained a large bowl of hot chocolate, with bread and butter. This I did every morning.

I was not given an opportunity to fly for several days. I was informed that I must wait until a new machine was completed. It is a rule that all new arrivals must make their first flight on a machine of only 50 horsepower. I found there was an oversupply of French mechanicians, there being about five to each machine. I wondered why there were so many until I saw the way they worked, and then I wondered no more. One good American mechanic can do more work in a day than five of them in a week.

**The First Test in the Air.**

My friend, Fileux, who was among the pilots, and I passed our first tests successfully, but the man (Corporal Delmas) who was tried out after us, wrecked the machine, which was a 50 horse-power Gnome-motored, Blériot monoplane, and caused us further delay.

I was beginning to get disgusted with the slowness of the French military system; therefore, I besought Capt. Duperron, through an interpreter, for some action, and was henceforth transferred to the "Rep" monoplane, a machine that easily makes 90 miles an hour. The Rep monoplane, equipped with an 80 horse-power Gnome motor, is quite a heavy apparatus, constructed mostly of steel, and in workmanship and materials it represents the best French aeronautical construction that I have seen.

**A Member of the "Rep" School.**

My opportunity to fly came the next day, and for the first time I enjoyed a flight of 30 minutes, which took me 2,000 meters (6,500 feet) high and gave me an opportunity to see the country about me. Tours is indeed a beautiful city. The day being a clear one, I could see the country for miles about; chateaux showed themselves here and there, and I should have liked to continue my flight, but, being permitted to fly for only a half hour, I was obliged to come down.

My friend, Fileux, seeing my success, also inquired of the captain for permission to be transferred to the Rep monoplane; and sad to say his first venture wound up disastrously, owing, perhaps, to his getting excited by the tremendous speed. He pulled back the elevating lever several inches, to rise, when he should have pulled it back about half an inch, and as a result, the machine shot straight up into the air for about thirty feet and then fell upon its side and nose like a wounded bird, completely smashing the apparatus, and, poor fellow, he is in the hospital, where he will be laid up for about a month, his right eye being hurt and his knees badly injured.

**A Collision Narrowly Averted.**

The following day, not having a machine to fly, and seeing a new Blériot monoplane flying, I requested the captain to let me fly it. I received permission, but was told by the captain that, as I was now in the Rep school I could fly that machine only, and that, therefore, this would be my last flight on the Blériot. I flew for 45 minutes and enjoyed it immensely, though I narrowly escaped death by collision in the air with a Nieuport monoplane. My machine was flying horizontally at an altitude of about 1,500 feet, when directly above me a pilot in a Nieuport was spiraling from a height of 5,000 feet, and coming directly toward me. I tried to steer out of its path, but he kept on coming toward me, and for the moment it appeared impossible to avert a collision. I attempted to dive, but had it not been for the fact that he peered out of the machine in my direction, nothing in the world would have saved me, since the speed of his machine doubled that of mine, and it was only by his immediate jerking of the elevating control toward him that he saved the situation. His machine was so close that the tail of his machine seemed to graze that of my machine, and the sudden rush of disturbed air was so violent that I had the greatest difficulty in keeping my apparatus from capsizing.

I remember only one other incident in my four years of flying where I was so close to death; this occurred the day of the baby parade at Asbury Park a year ago; when, with my apparatus directly over the parade, my motor stopped, and I crashed through the branches of a large tree near the baseball park, from which point I had started my flight.

The next morning a new arrival to the Second Aviation Reserve at Tours did the same to the Blériot monoplane I had flown the day before as my friend Fileux had done. This made the third machine I had flown at Tours that was completely demolished the next day. This poor chap, though unhurt, is now serving a thirty-day term in jail, as it was learned that he had never been in a machine before in his life.

**Qualifying for Pilot.**

Two days later, Friday, October 9th, proved an eventful day for me. A new 80 horse-power Rep monoplane had arrived, and I was given permission to fly it. I did so for twenty minutes, and then I was given permission to qualify for my military brevet. The recording barometer was secured and fastened to the machine by the mechanics, but after flying for five minutes it worked loose, and I was forced to descend for a fresh start—an example of the work done by the French mechanics. This time it was fastened more securely. I arose to a height of 2,500 meters (8,200 feet) in twenty minutes, and then straightened out my machine to remain there for one hour or more; but alas! after flying for thirty minutes at this altitude, the barometer refused to operate, and I had to descend.

I made a fresh start at three o'clock in the afternoon. This time I fastened the barograph myself, by a cord around my neck, the barograph resting against my chest, to which I had fastened a mirror in order to note its operation while in flight. A small aneroid, a stationary part of the machine, capable of registering 3,000 meters, acted as a guide when once I attained the height of 2,000 meters.

I bundled up good and warm with safety helmet, goggles, sweater, leather coat, and gloves. I flew for one hour and forty-five minutes, one hour and fifteen minutes of this at the height of 2,200 meters (7,200 feet). The barometer worked perfectly, and I had flown all over the neighboring country, which consisted of large dense woods, rivers Share and Loire, large cities and small towns, and I certainly enjoyed my stay in the air at this altitude, although it was terribly cold, and I was really glad to descend once again to Mother Earth. The recording barometer having worked satisfactorily, I was given my military license by the military officials, who congratulated me upon being the first and only American licensed aviator to fulfill the test. I now await the arrival of the brevet from the Minister of War and the Director of Aeronautics, both of whose approvals I must have before it is issued, since upon its receipt I am ready to be sent to the front. I was informed by the captain that he had received instructions from headquarters that four licensed Rep monoplane pilots were wanted in a few days to pilot machines to the front; so I was rather pleased to have obtained my license, as I was tired of wasting valuable time when I could be accomplishing something and be of some use to France.

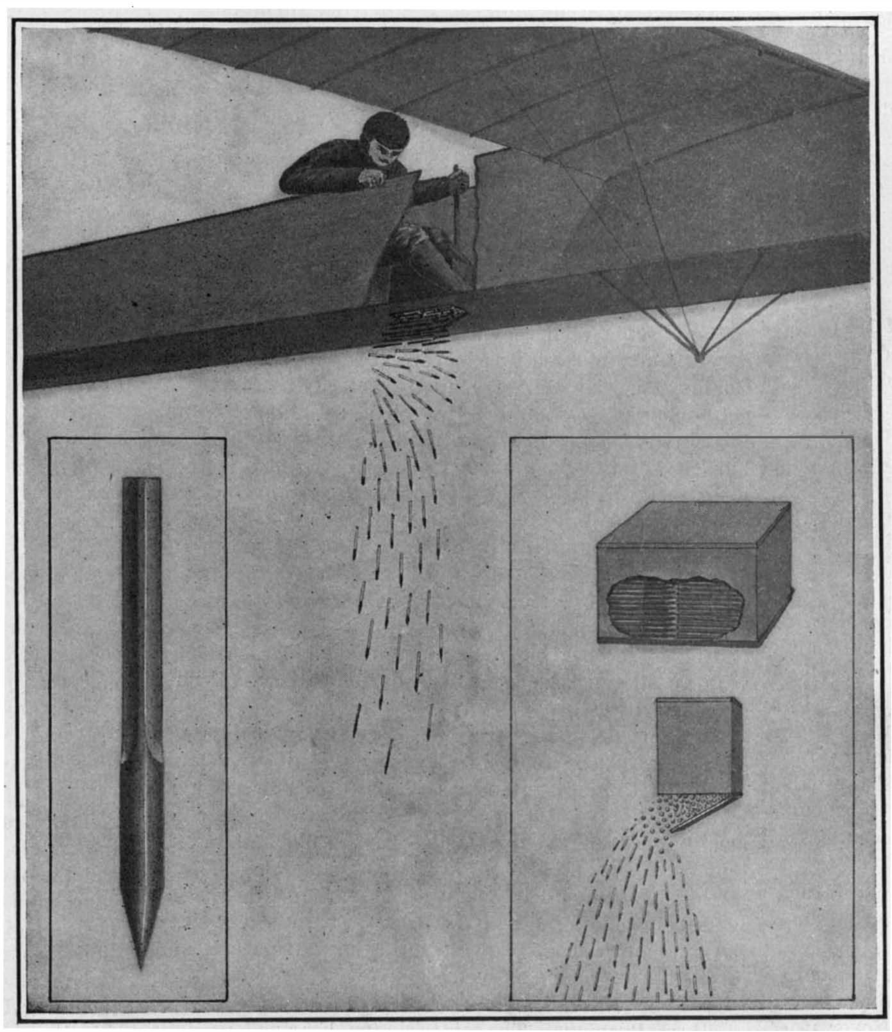
**Machines Discarded by the French Government.**

Three days after having qualified for my military brevet, an important order was issued by the Director of Aeronautics, which affected a great many pilots and demonstrated the inefficiency of certain apparatus. The order ran as follows:

In future there shall be no more Blériot, Rep, Nieuport, or Deperdussin monoplanes used by the French government, and all those pilots learning or now operating any of these machines must immediately change to either of the following apparatus: Morane-Saulner monoplane, Henry Farman biplane, Maurice Farman biplane, Caudron biplane, or the Voissan biplane.

I immediately changed to the Morane-Saulner monoplane, a smaller machine in comparison to the Rep monoplane, but con-

(Concluded on page 38.)



**How steel darts are dropped from an aeroplane.**

Insert on the left shows a dart about half size; on the right, the box from which they are discharged.

* Copyright, 1915, by Munn & Co., Inc.

# American Automobile Coachwork

## Criticism of Domestic and Foreign Car Bodies

By John Jay Ide

THE bodies of American motor cars produced for the season of 1914 exhibited a noteworthy advance over those of the preceding season. A certain number of manufacturers realized that they could learn something from foreign design with the result that not a few cars boasted hoods tapering into the cowls, giving the proud designer the opportunity of calling the child of his brain "a true streamline production." Even where no transition between hood and dash was attempted, that typical American institution—the windshield with massive brass stay rods, which rendered the engine so difficult of access—was in many cases replaced by one fastened securely enough to the cowl to need no external bracing. In a very few cases the one-man top fastening onto the windshield was adopted, thus rendering unnecessary another eyesore: the straps connecting the front of the top with the frame or mudguards as the case might be.

For 1915 these tendencies find wider expression, and it is now the exception rather than the rule to see a new model offending in the above respects. A few makers have copied a certain Belgian car in supplying pointed radiators. A greater number have followed the lead of a certain French "marque" of racing fame in rounding off the radiator top, thus eliminating the hard edge.

In most of the cheaper cars sidelights have ceased to exist on the claim that they interfere with the streamline effect. A dimmer attachment in the headlamps is substituted for them. Most of the higher priced cars, however, retain sidelights either in combination with the headlights or in their accustomed place at the dash.

Many makers advertise "crowned" mudguards; a few have gone further and have adopted domed guards. The latter is certainly the final type, but stress should be laid upon the desirability of having the valance and mudguard in one piece. This not only eliminates a possible source of squeaking, but greatly improves the appearance of the car.

Most of our designers have not yet learned to make the rear fenders follow the curve of the wheels. Beginning too near the tire on account of the presence of the door, the mudguard steadily diverges therefrom until at its rear end it is often as much as 9 inches away. It may be urged that this is done to allow for depression caused by weighty passengers in the rear seat. As a matter of fact the depression is barely perceptible in the most heavily laden cars owing to the stiffness of the springs.

Both front and rear fenders would be much more efficient if they were brought closer to their respective wheels. After all, only sufficient space is needed to allow for the spring compression on the wheel's striking an obstacle. There is much to be said in this respect for the mudguards attached to the stub-axles and following the vertical movements of the wheels. These have been tried both here and abroad, but difficulty has been experienced in attaching them securely. Surely this can be overcome.

As remarked above, one-man tops have become general, so that entrance to the front seats is no longer blocked by the bows. The obstruction caused by the bows was one of the greatest defects of the old-fashioned top, and it is astonishing that the one-man type was not adopted here before 1914, as it has been used in England a number of years. Another inconvenience has also happily been removed. That was the gap between the top of the windshield and the front of the top, often just large enough to allow the rain to drift in and wet the occupants.

A number of makers now inclose the top completely when down, not even allowing the bows to peep out of their housing. This is one step toward the incorporation of the top in the body, credit for which must be given to a noted Berlin coachmaker who exhibited a remarkable body at the European shows in November, 1912. As shown in Fig. 1 the lines of the top casing are very agreeably led off into the rear panel. When out of use the top is completely boxed in by three detachable sections. The general appearance is very pleasing indeed, but it is difficult to imagine anything not superior to the ordinary top when folded down.

Apart from the top casing the body has many points of originality. The sidelights are placed on the mudguards, where they fulfill their true function of indicating the real width of the vehicle. The divided rear seats are of the adjustable Pullman type. Behind the front seats is a cowl protecting a cupboard with several drawers. It will be seen that no upholstery protrudes above the body sides. The round hole adjacent to the levers is the gauze covered horn orifice. Except for the external levers and the mudguards this body is still in advance of current touring car design.

Fig. 2 represents the latest model of the same firm. As in the previous body one can hardly detect the rear end of the hood. When it is desired to light the headlamps the front sections are removed and clipped upon the rear portions.

A German sporting model is shown in Fig. 3. Rather than mold the bonnet to suit the body the designer has forced the latter into an ugly form. The windshield is interesting as the glass of the stationary portion is cut to fit the bonnet curve, there being no filler board. The external exhaust trunk, elementary mudguards, disk wheels and pointed radiator are in keeping with the character of the design.

The French berline in Fig. 4 has an overall height of slightly less than six feet. This body might be studied with advantage by the makers of some of our ponderous eight-foot chariots. Although of the single-compartment type it has a separate entrance for the front seats, a solution not without certain advantages. Sufficient headroom is obtained for the rear seats by sinking the floor below the chassis level.

To England must go the credit for developing the cabriolet, an example of which

*(Concluded on page 40.)*

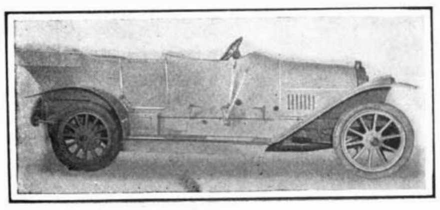


Fig. 1.—Top snugly housed.

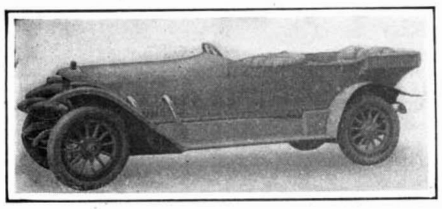


Fig. 2.—Streamline headlights.

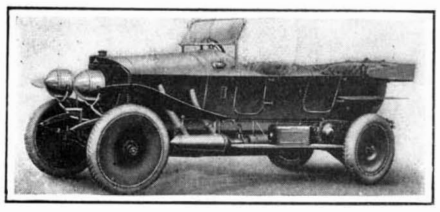


Fig. 3.—Note ungraceful lines.

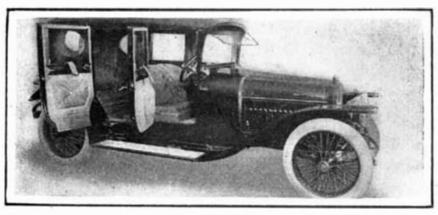


Fig. 4.—A French berline.

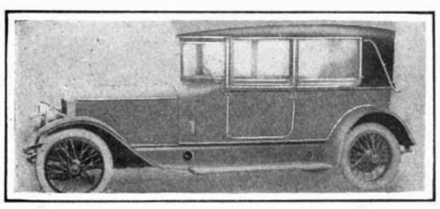


Fig. 5.—An English cabriolet.

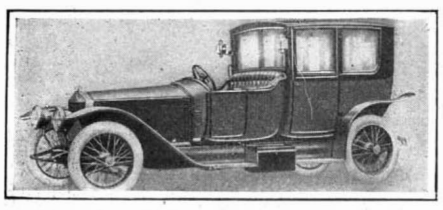


Fig. 6.—English town car.

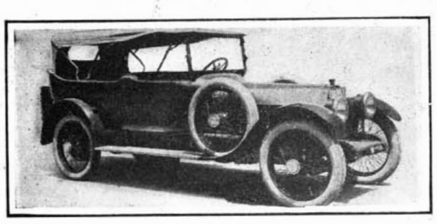


Fig. 7.—American touring body.

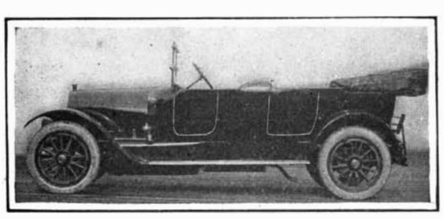


Fig. 8.—Rather inelegant design.

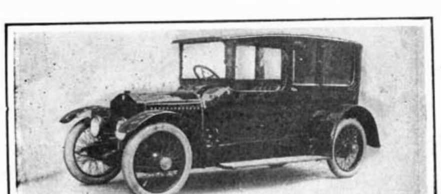


Fig. 9.—Very harmonious design.

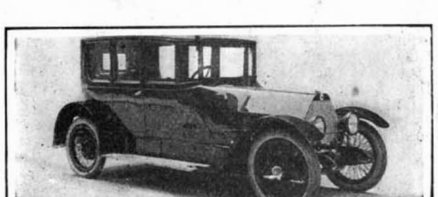


Fig. 10.—Clean cut berline.

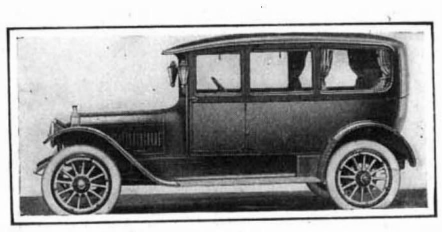


Fig. 11.—A novel sedan.

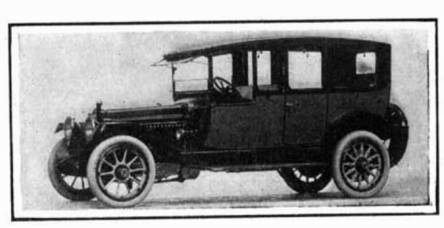


Fig. 12.—A pleasing limousine.

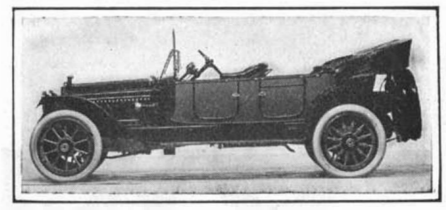


Fig. 13.—Shows broken lines.

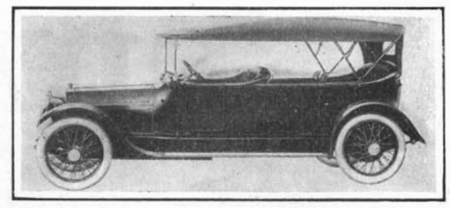


Fig. 14.—Symmetrical touring body.

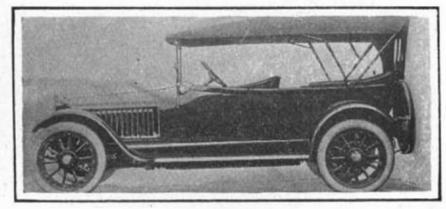


Fig. 15.—Boat type body.

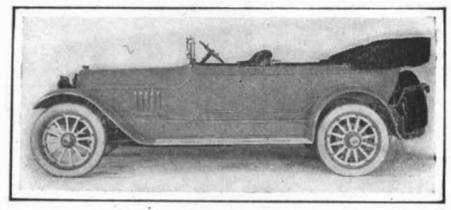


Fig. 16.—Too many moldings.

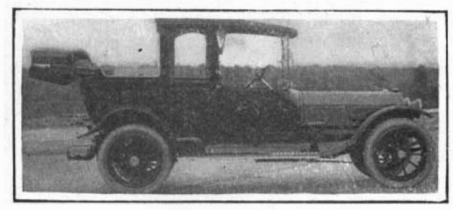


Fig. 17.—An unsuccessful design.

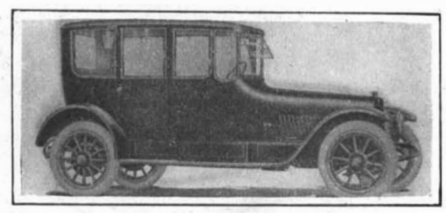


Fig. 18.—A fine sedan.

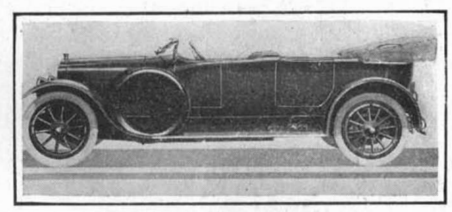


Fig. 19.—Handsome American tourist.

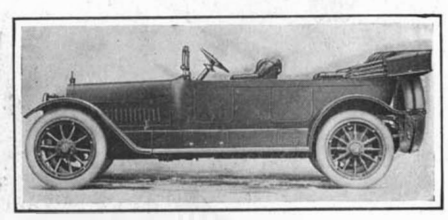


Fig. 20.—Has too low a side.

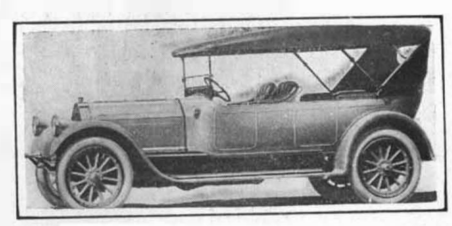


Fig. 21.—Rather low-sided.

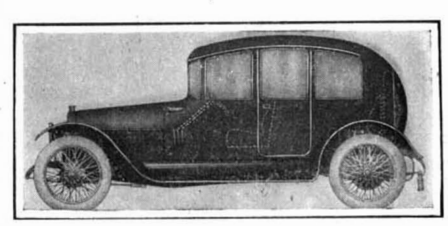


Fig. 22.—A sedan design of 1912.


Over 3,000 Dealers
anxious to shift to—
Studebaker
About 20% of all the dealers in the country, within 60 days of the close of their 1914 experiences, applied for a Studebaker agency and the opportunity to have their names linked with Studebaker reputation. These were BUSINESS MEN, choosing an automobile as an INVESTMENT not as a luxury.
The soundness of their judgment was a vital thing to them, for it meant the measure of their success. They based that judgment on their past experience and their confidence in what Studebaker meant in value, and like other sound business men in these days, refused to gamble.
To these men—"Because it's a Studebaker" was not an empty phrase. They KNEW that the forty-five millions of capitalization behind the Studebaker Corporation was in fact a forty-five million dollar GUARANTEE behind each car they sold. They KNEW that the prestige around the name Studebaker, built gradually through sixty-three years of business integrity was another surety of a product that MUST live up to expectations. They KNEW that just as surely as Studebaker could not afford to MAKE poor cars, neither could they afford to SELL them poorly and that a Studebaker dealer carries an endorsement to the public of high standing in his community.
The unconscious advice that is given you by these experts should appeal to you as a business man. Self-protection in a year of business uncertainty was the motive behind their choice. Real knowledge of relative values earned by past experience guided them. A solid dependable certainty was what they sought—and found in Studebaker.
You who are buying a car may well consider the judgment of these 3,000 and more merchants whose knowledge of automobile values is their business asset.
Studebaker Roadster $985
Studebaker FOUR $985
Studebaker SIX $1385
Specifications
Studebaker SIX
Electric starter, electric lights.
Tires, safety tread on the rear wheels, 34 x 4—Goodrich.
One-man type top, good quality silk mohair. Top boot.
High grade, large size Stewart-Warner magnetic speedometer.
New design locking ignition and lighting switches.
Full floating rear axles.
Complete equipment of Timken bearings.
Windshield made expressly for Studebaker bodies, rain and storm proof—adjustable to rain and clear vision and ventilation.
Extra deep upholstering.
Complete set of high grade tools, pump and jack.
Electric horn, with button set in center of steering wheel.
Magnetic gasoline tank gauge.
Studebaker-Schebler carburetor with dash adjustment.
Quick detachable, demountable rims, with extra rim carried on locking tire carrier at rear of body.
Studebaker stowaway side curtains.
Studebaker FOUR
Electric starter, electric lights.
Extra size tires, safety tread on the rear wheels, 33 x 4—Goodrich.
One-man type top, good quality silk mohair. Top boot.
High grade, large size Stewart-Warner magnetic speedometer.
New design locking ignition and lighting switches.
Full floating rear axles.
Complete equipment of Timken bearings.
Windshield made expressly for Studebaker bodies, rain and storm proof—adjustable to rain and clear vision and ventilation.
Extra deep upholstering.
Complete set of high grade tools, pump and jack.
Electric horn, with button set in center of steering wheel.
Magnetic gasoline tank gauge.
Studebaker-Schebler carburetor with dash adjustment.
Quick detachable demountable rims, with extra rim carried on locking tire carrier at rear of body.
Studebaker stowaway side curtains.
Studebaker Roadster
Electric starter, electric lights.
Extra size tires, safety tread on the rear wheels. 33 x 4—Goodrich.
One-man type top, good quality silk mohair. Top boot.
High grade, large size Stewart-Warner magnetic speedometer.
New design locking ignition and lighting switches.
Full floating rear axles.
Complete equipment on Timken bearings.
Windshield made expressly for Studebaker bodies, rain and storm proof—adjustable to rain and clear vision and ventilation.
Extra deep upholstering.
Complete set of high grade tools, pump and jack.
Electric horn, with button set in center of steering wheel.
Magnetic gasoline tank gauge.
Studebaker-Schebler carburetor with dash adjustment.
Quick detachable, demountable rims, with extra rim carried on locking tire carrier at rear of body.
Studebaker stowaway side curtains.
Special three seating body.
Adjustable pedals.
STUDEBAKER—DETROIT
Canadian Plant—Walkerville, Ont.

# The Heavens in January

## Weighing and Measuring a Star 200 Light Years Distant from the Earth

By Henry Norris Russell, Ph.D.

THE distances of many of the stars are now fairly well known; their real brightness compared with that of the Sun may frequently be calculated; we know the densities of about ninety stars and the masses of a rather smaller number. But there are very few cases in which the actual size of a star—its diameter in miles—can be determined, and, therefore, a new instance of the sort well deserves discussion here.

The star in question, known as RX Herculis, is of the seventh magnitude and quite invisible to the unaided eye. As its designation indicates to the initiated, it is variable in brightness, and the fact that we can determine its actual size adds to the discerning mind the information that the variability must be due to eclipse and that it must have been observed with the spectroscope.

Attention was first called to this star when it was found that it lost about 40 per cent of its light at intervals of 21 hours 20 minutes and 34 seconds, remaining constant in brightness for all but about 5 hours of this interval. This behavior showed at once that the loss of light must be due to an eclipse by some attendant body, as in so many other cases.

Spectroscopic observations by Prof. Frost at the Yerkes observatory showed that the lines in the spectrum became double in the interval between eclipses, and thus proved that the companion as well as the principal star was bright, so that their spectra appeared simultaneously when one was rushing toward us after it had been eclipsed, and the other receding. Long series of accurate measures of the brightness of this star have been made at Harvard by the late Prof. Wendell, and at Princeton by Dr. Shapley (now of the Mount Wilson staff), by whom the calculations here described have been carried out.

These two sets of measures agree perfectly, and show that, outside the eclipses, there is not the least variation in light. Successive eclipses, however, are slightly unequal in magnitude, the maximum observation being alternately 40.8 and 35.7 per cent of the light at maximum. This small difference is demonstrated beyond question by the observations. Its explanation is fairly obvious. The two stars, which revolve around one another, are slightly unequal in brightness. One gives off a little more light per square inch than the other, and so when the former is eclipsed a little more light is lost than in the opposite case. As the stars circle about their common center of gravity, each in turn partially eclipses the other, and the observed situation follows. The actual period of revolution must then be double that between eclipses, or 1 day 18 hours 41 minutes 8.79 seconds, according to Dr. Shapley. As the time of the middle of eclipse can be determined within a very few minutes, and it has been under observation for fourteen years, or nearly 3,000 revolutions of the system, it is clear that this value can be at most a couple of hundredths of a second out of the way.

The orbits in which these two stars move about their center of gravity must be practically circular; for the shallower eclipses come just half way between the deeper ones and last equally long, and if the orbit was eccentric this could not be the case.

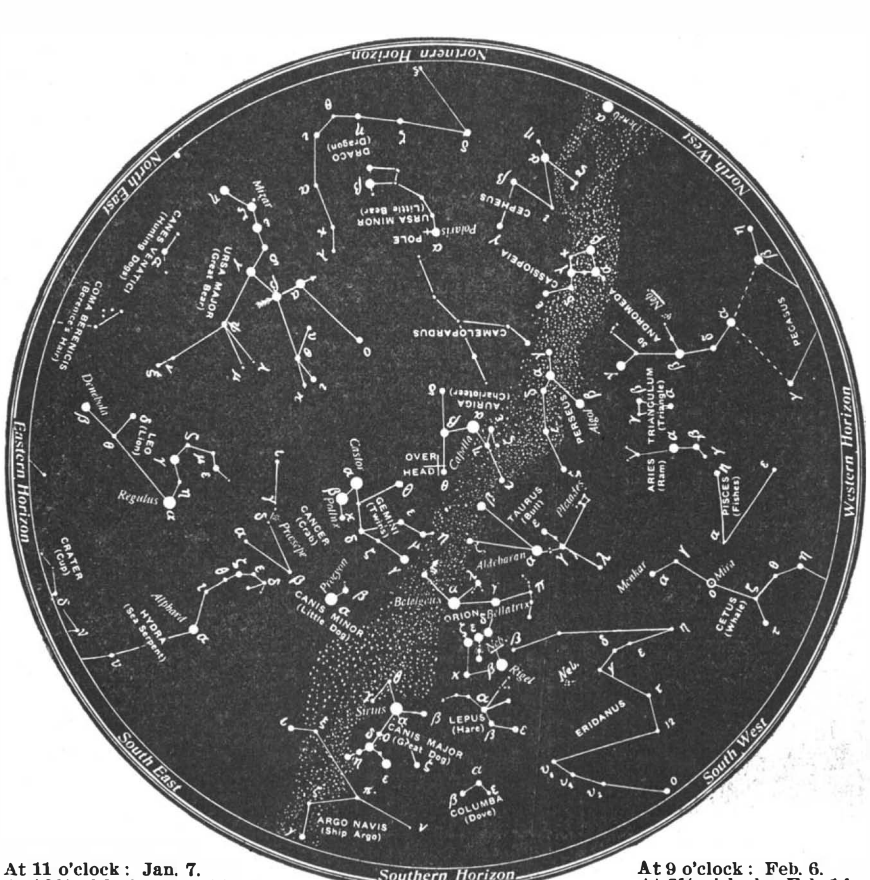
So much has now been found out about this system by very simple reasoning that it is not surprising that a great deal more can be discovered by calculation based on the photometric observations (which give the relative sizes and brightness of the stars) and the spectroscopic data (which give the actual size of the orbit, and hence of the stars, in miles). We may, therefore, pass to Dr. Shapley's summary of his conclusions, which is substantially as follows:

The system of RX Herculis consists of two stars of equal mass and nearly equal brightness, which revolve about their common center of gravity in circular orbits of equal size at distances of 1,620,000 miles on opposite sides of the center, or 3,240,000 miles from one another, completing a revolution in 1 day 18 hours 41 minutes, as aforesaid.

The plane of this orbit makes an angle of only 4 degrees with the line of sight from us to the star, so that each star eclipses the other once in every revolution. The larger star, 1,300,000 miles in diameter, does not shine quite so brightly per square mile as the smaller, so that the latter, though but 1,170,000 miles in diameter, gives out eleven twelfths as much light as the other. When the smaller star goes behind the larger only a thin crescent of about one seventh the width of the whole disk remains in sight. This gives the principal (deeper) eclipse. When the small star comes in front of the larger, we get the secondary and shallower eclipse.

The mass of each star is 89 per cent of that of the Sun (unusually small for a white star like this), and the density of the larger one is one quarter, and that of the smaller one third of the Sun's density.

If the stars give off as much light per square mile as does the Sun their distance from us must be such that light would take 200 years to travel it. But the spectrum of the stars closely resembles that of Sirius or Vega, and it is very probable that stars of this sort are much hotter (at least on the surface) than the Sun, and shine far more brightly—giving out from



At 11 o'clock: Jan. 7.
At 10½ o'clock: Jan. 14.
At 10 o'clock: Jan. 22.

At 9½ o'clock: January 29.

At 9 o'clock: Feb. 6.
At 8½ o'clock: Feb. 14.
At 8 o'clock: Feb. 21.

NIGHT SKY: JANUARY AND FEBRUARY

six to ten times as much light per square mile. On this basis, therefore, the distance of the system may be estimated as 500 light years (or thirty million times the distance of the Sun), and the light emission of the pair as fully thirty times that of the center of our system. If this be true the eclipses recently observed actually took place long before Columbus discovered the New World, and more than ten thousand other eclipses of each star by the other have happened since, and are, so to speak, on their way to us—the light which will announce them being still far in the depths of interstellar space.

It is really amazing that, by means of observations which, if a full account was kept of the time taken, would aggregate less than a month's work by one observer, so much information about the nature of a star at so immense a distance can be obtained.

### The Heavens.

The southern sky now displays its full splendor. Orion marches proudly across the meridian, confronting the Bull with upraised arms, while the Great and Little Dogs follow their master, and we may, if we will, imagine that the Little Hare and the Dove are escaping for dear life. But we cannot carry our mythological picture much farther without getting into a helpless jumble of ships and sea serpents and crabs and twin babies; so it may be well to return from the constellations to the stars.

In the dull southwestern sky we may note our near neighbors. $\delta$ and $\epsilon$ Eridani and $\tau$ Ceti, and the famous variable Omicron Ceti (Mira) now rapidly rising toward maximum. Farther to the right and west of north one may, on the brilliant nights of winter, see at their best the nebula of Andromeda and the great star cluster in Perseus (between this constellation and Cassiopeia) and then facing about, compare these with Praesepe in Cancer—a cluster which, unlike that in Perseus, is resolvable into its component stars in a field-glass.

From the very appearance of this cluster one would judge that it was nearer than the other, and this is probably true—though if Schwarzschild's estimate of 500 light years for its distance be correct, as seems very likely, it is hardly what even an astronomer would ordinarily call a neighboring object. Kapteyn, in the case of the Perseus cluster, concludes that it is probably 1,600 light years off at the least, and perhaps very much farther.

As for the Andromeda nebula, hardly anyone would dare even to guess at its distance, but as its spectrum resembles that of a star cluster, and no separate stars can be seen, even with the greatest telescopes, it may be vastly more distant still. Turning back to the east, we find Leo well above the horizon, and Ursa Major coming up on the northeast; and the familiar constellations about the pole complete our survey.

### The Planets.

Mercury is practically invisible at the beginning of the year, but comes out into the evening sky, and by the end of January is well visible, setting at 6:30 P. M. By the end of the month he is close to Jupiter, and the two form a pretty pair, Jupiter appearing about twice as bright as Mercury.

Venus is morning star, and at her greatest brilliancy as the year opens—twelve times brighter than Jupiter. She rises at 4 A. M. or a little after all through the month, and is the glory of the morning sky.

Mars, having just passed conjunction with the Sun, is theoretically a morning star and practically invisible.

Jupiter is evening star in Capricornus and visible now only in the early evening. Saturn is in Gemini, just past opposition and a splendid object both to the eye and telescope. He is so bright that he quite changes the appearance of even the brilliant region of the heavens through which he is passing.

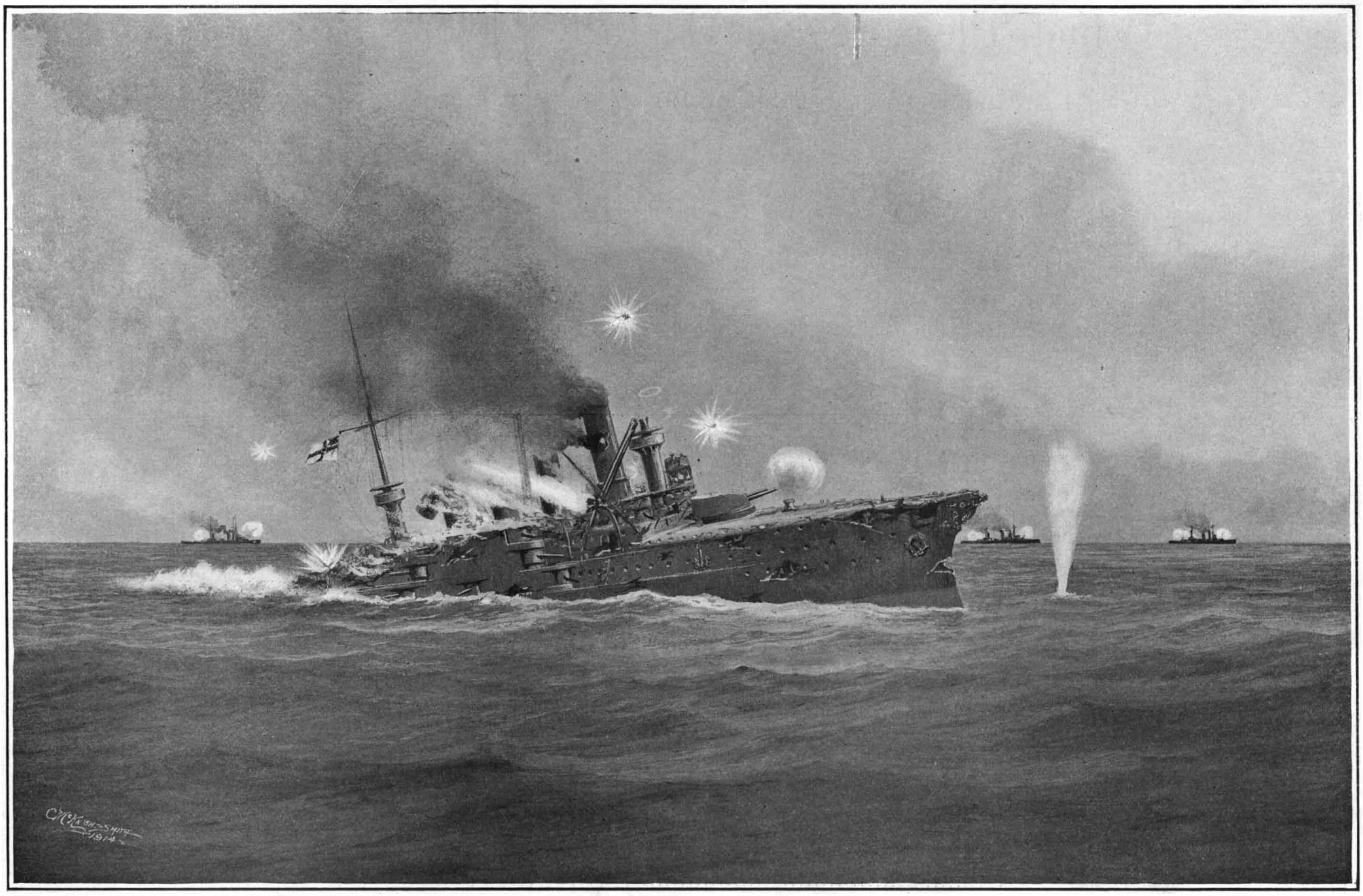
Uranus is so low in the west at sundown as to be unobservable. Neptune, on the other hand, is in opposition on the 19th, and favorably placed. On December 31st his right ascension is 8 hours 6 minutes 46 seconds and his declination 19 degrees 52 minutes north. On February 1st these co-ordinates have become 8 hours 3 minutes 5 seconds, 20 degrees 4 minutes north. This puts him about 8 degrees west of Praesepe and 2 degrees north of the fine triple star $\zeta$ Cancri—where the observer who has a three-inch telescope and a star-chart, or the patience to make one for himself, may find him.

The Moon is full at 7 A. M. on the 1st, in her last quarter at 4 P. M. on the 8th, new at 10 A. M. on the 15th, in her first quarter at 1 A. M. on the 23rd, and full again at 11 P. M. on the 30th. She is nearest the Earth on the 12th, and farthest away on the 24th. She passes near Venus on the 12th, Mars on the 14th, Mercury on the 15th, Uranus on the 16th, Jupiter on the 17th, Saturn on the 27th, and Neptune on the 30th.

Princeton University Observatory.

## Shipping Eggs by Parcel Post

THIS is a subject in which both the Post Office Department and the Department of Agriculture have, of late, been greatly interested. During the period October, 1913-February, 1914, the Office of Markets carried out a thorough test, consisting of no less than 466 shipments, aggregating 761 dozen eggs, sent over various distances, under various conditions, and in various types of containers. Some of the longest shipments were between Washington and Minneapolis and between Washington and the Rocky Mountains. The total breakage was 327 eggs, of which only 209 were broken beyond use, and of these 91 were broken because the parcels containing them were not handled in accordance with postal regulations. Subtracting these, the loss was less than 1.3 per cent.



**The "Scharnhorst" going down at the close of the engagement, off the Falkland Islands, with Admiral von Spee's flag at the main yard.**

# The Sinking of the German Pacific Squadron

## Superior Speed and the Long-Range Guns Win a Running Fight

By piecing together the many cabled accounts of the late British-German cruiser action off the Falkland Islands in the South Atlantic, we are able to gather a fairly accurate impression of that highly dramatic sea fight. The encounter marked the successful end of a search for the German ships undertaken by Vice-Admiral Sturdee with the battle-cruisers "Invincible" and "Inflexible" and a group of five smaller vessels.

As will be seen from the enumeration given below, the British squadron possessed a superiority in armor-piercing guns and armor as overwhelming as that which enabled Von Spee to crush the British squadron under Cradock a few weeks before.

The British fleet consisted of the battle-cruisers "Invincible" and "Inflexible," the armored cruisers "Carnarvon," "Cornwall" and "Kent," and the scout-cruisers "Bristol" and "Glasgow." In the German fleet were the armored cruisers "Scharnhorst" and "Gneisenau," the protected cruiser "Leipzig," and the two fast scout-cruisers "Nurnberg" and "Dresden."

When last heard from, Von Spee's squadron, after coaling at Valparaiso, had steamed south. Apparently his objective was the British coaling station at Port Stanley in the Falkland Islands; and a rumor (to which too much credence should not be given) has it that the converted cruiser "Prinz Eitel Friederich," with troops on board for the occupation of the station, accompanied the squadron.

Be that as it may, on the morning of December 8th the "Canopus," an old battleship with 6-inch armor and 35-caliber guns, and the British armored cruisers and scouts, which were cruising outside the land-locked bay on which Port Stanley is located, saw the German squadron lifting above the horizon. The two British battle-cruisers were inside, coaling, and according to dispatches were not visible to Von Spee. To the German admiral it looked like an even fight, for, although it was six ships to five, there was no vessel in the British force that could match the "Scharnhorst" and "Gneisenau." So down he drove, with ships cleared for action. Von Spee's flagship, the "Scharnhorst," was the gold medal ship for gunnery in the German navy, and it was her 8.2-inch salvos that had contributed mainly to the sinking of the "Good Hope" and "Monmouth."

The fight was no sooner well under way, we are told, than out of Port Stanley steamed the two battle-cruisers. They took on the "Scharnhorst" and "Gneisenau" and left the smaller ships to fight it out among themselves. Von Spee signaled his fleet to scatter, and himself ranged up for the last, bravely-fought battle of his life.

It would be very interesting to know at what range the fight between these four ships was fought. Theoretically, Admiral Sturdee, having the more powerful gun and the higher speed, should have fought just outside the range at which the 8.2-inch shells of the Germans could land with serious effect. Judging from the fact that the action lasted from 1 P. M. to 6 P. M. and that the total casualties in the whole British fleet were only nine killed and a few wounded, it is probable that Sturdee, having the speed gage, fought at an extreme range, probably 12,000 to 14,000 yards, being content to sink the German ships gradually with a minimum loss of his own personnel.

BRITISH SQUADRON.

| Name. | Type. | Date. | Displace'mt. | Belt armor. | Guns. | Speed. |
|---|---|---|---|---|---|---|
| "Invincible" | Battle Cruiser | 1908 | 17,250 tons | 7-inch | 8-12",16-4" | 26.5 |
| "Inflexible" | Battle Cruiser | 1908 | 17,250 tons | 7-inch | 8-12", 16-4" | 26.5 |
| "Carnarvon" | Armored Cruiser | 1904 | 10,850 tons | 6-inch | 4-7.5", 6-6" | 23.0 |
| "Cornwall" | Armored Cruiser | 1901 | 9,800 tons | 4-inch | 14-6" | 23.5 |
| "Kent" | Armored Cruiser | 1903 | 9,800 tons | 4-inch | 14-6" | 23.0 |
| "Bristol" | Scout Cruiser | 1911 | 4,800 tons | none | 2-6", 10-4" | 26.5 |
| "Glasgow" | Scout Cruiser | 1911 | 4,800 tons | none | 2-6", 10-4" | 26.5 |
| "Canopus" | Coast Defense Ship | 1897 | 12,950 tons | 6-inch | 4-35cal. 12", 12-6" | 16.5 |
| GERMAN SQUADRON. | | | | | | |
| "Scharnhorst" | Armored Cruiser | 1907 | 11,600 tons | 6-inch | 8-8.2", 6-6" | 23.5 |
| "Gneisenau" | Armored Cruiser | 1907 | 11,600 tons | 6-inch | 8-8.2", 6-6" | 23.5 |
| "Leipzig" | Protected Cruiser | 1906 | 3,250 tons | none | 10-4" | 23.0 |
| "Nurnberg" | Scout Cruiser" | 1908 | 3,450 tons | none | 10-4" | 24.0 |
| "Dresden" | Scout Cruiser | 1908 | 3,600 tons | none | 10-4" | 24.0 |

The Germans fought it out with characteristic courage to the very end, the "Scharnhorst" going down by the stern, with the admiral's flag flying from the main yard. The "Gneisenau" went under a little later; and after a spirited action the "Glasgow," which was in the Chilean fight, sunk the "Leipzig." Subsequently the "Nurnberg" was overtaken and sent to the bottom. The "Dresden" escaped and is still at large.

### A New Cement Product

It is likely that South Germany will furnish a supply of trass for cement making that promises to be of value. It has recently been found that the volcanic tufa which makes up the subsoil between Bischingen and Tapfheim is quite superior to the trass of the Rhine region. The new trass of the Danube, however, presents, in the usual method of cement mixing (1 part each of trass, lime and sand with water), an excellent resistance to strains, and the qualities of the trass mortar will allow it to replace cement mortar, the cost of which is 50 per cent higher. Such mortar is slower in hardening than cement mortar, but on the other hand is said to be more elastic, stronger, and less porous. Besides, it is rare that such mortar, when well prepared, will show cracks as in the usual cases. It can be worked as well in very cold weather as at other temperatures, so that it can be used throughout the winter. When in the powdered state, trass does not suffer from dampness, and is not deteriorated by lying in storehouse for long periods. Another point is that 100 parts of it give as much mortar as 150 parts of cement. The operating of the trass quarries in south Germany promises to be a good venture, for there is no doubt among competent authorities that ordinary cements can be replaced by this material.

**Federal Aid for Good Roads.**—The American Road Congress, recently held at Atlanta, endorsed the principle of Federal co-operation toward the construction of main highways in the several States, and the Government was urged to construct roads across all Indian reservations, forest reservations and other federalized areas where such connecting links are essential parts of through routes of travel. Uniform road legislation was urged on all States, as well as the passage of road laws in those States as have not yet done so.

# Which Pleasure Car Fits the Buyer's Purse?

## A Price List and Reference Table of 1915 American Gasoline Pleasure Cars

Compiled by C. Edward Palmer

*DURING the past year or two the trend in automobile design has been toward the refinement of details, the strengthening of weak points, and simplification of operation. Except in a few specific instances, no marked changes in design have been made, although many manufacturers have amplified body construction and added features here and there, which have made for luxury, both for passengers and driver. Whereas, three or four seasons ago, the electric starting and lighting system attracted much attention at the automobile shows, this year it is supplied as regular equipment on more than 90 per cent of the cars manufactured in this country.*

*For the average prospective purchaser, the problem of buying a car has narrowed down to the question, "Which car fits my purse?" Within the range of price he can pay, the customer will find a large number of cars to select from. It is with the object of assisting such visitors at the automobile shows or salesrooms that the following tables have been compiled.*

*Except for the abbreviations used, the table is self-explanatory. In each price column the first figure indicates the number of cylinders, while the second gives the rated horse-power. The small letters refer to the type of body which may be obtained with that particular chassis at the price indicated, while the capital letters tell whether the car is equipped with self-starter and electric lights. Thus, r means roadster body; t, touring car; c, coupé; s, sedan; p, phaeton; b, berline; l, limousine, and ld, landaulet. S indicates self-starter, and E, electric lights.*

*While the table does not include every car manufactured in the country, nor does it include all companies making only a few cars per year, it does give the more important and representative models of the companies listed. Where further information is desired, manufacturers will supply catalogues, detailed specifications, etc., on request.*

| Name of Car | Name and Address of Manufacturer | Under $700 | $700 to $1,200 | $1,201 to $2,000 | $2,001 to $3,000 | $3,001 to $4,000 | Over $4,000 |
|---|---|---|---|---|---|---|---|
| Abbott-Detroit | Abbott Motor Car Co., Detroit, Mich. | | | 4, 40, r,t,S,E, $1,875 | 6, 60, r,t,S,E, $2,290 | 6, 60, l,S,E, $3,500 | |
| Allen | Allen Motor Co., Fostoria, O. | | 4, 35, r,t,S,E, $895 | 4, 40, r,t,S,E, $1,395 | | | |
| Alter | Alter Motor Car Co., Plymouth, Mich | 4, 27, r,t,S,E, $685 | | | | | |
| Ames | Ames Motor Car Co., Owensboro, Ky | | | 4, 27, r,t,S,E, $1,785 | | | |
| A. E. C | Auger Eng. Co., Milwaukee, Wis | | | | 6, 50, r,t,S,E, $2,500<br>6, 60, r,t,S,E, $2,750 | | |
| Apperson | Apperson Bros. Auto Co., Kokomo, Ind | | | 4, t,S,E, $1,350<br>6, t,S,E, $1,485 | 6, r,t,S,E, $2,200 | | |
| ArBenz | ArBenz Car Co., Chillicothe, Ohio | | | 4, 48, r,S,E, $1,825<br>4, 48, t,S,E, $1,885 | | | |
| Auburn | Auburn Automobile Co., Auburn, Ind | | 4, 36, r,t,S,E, $1,075 | 6, 47, t,S,E, $2,000 | | | |
| Austin | Austin Automobile Co., Grand Rapids, Mich. | | | | | 6, 49, r,t,S,E, $3,600 | 6, 49, l,S,E, $4,700 |
| Benham | Benham Manufacturing Co., Detroit, Mich. | | | | 6, 48, r,t,S,E, $2,485 | | |
| Briscoe | Briscoe Motor Co., Inc., Jackson, Mich | | 4, 30, r,t,S,E, $785 | 4, 30, c,S,E, $1,250 | | | |
| Buick | Buick Motor Co., Flint, Mich | | 4, 28, r,t,S,E, $900 | 4, 37, t,S,E, $1,250<br>6, 55, t,S,E, $1,650 | | | |
| Cadillac | Cadillac Motor Car Co., Detroit, Mich | | | 8, 31 to 60 r,t,S,E, $1,975 | 8, 31 to 60, ld,S,E, $2,500 | 8, 31 to 60, l,S,E, $3,450 | |
| Cartercar | Cartercar Co., Pontiac, Mich | | | 4, 30, r,t,S,E, $1,250 | | | |
| Case | J. I. Case T. M. Co., Inc., Racine, Wis | | | 4, 40, t,S,E, $1,800<br>4, 25, r,t,S,E, $1,350 | | | |
| Chadwick | Chadwick Engine Works, Pottstown, Pa | | | | | | 6, 60, r,t,S,E, $5,500<br>6, 60, l,S,E, $6,500 |
| Chalmers | Chalmers Motor Co., Detroit, Mich | | | 6, 48, r,t,S,E, $1,650 | 6, 60, t,S,E, $2,400 | 6, 48, c,s,S,E, $3,200 | |
| Chandler | Chandler Motor Car Co., Cleveland, O | | | 6, 35, r,t,S,E, $1,595 | 6, 35, l,s,S,E, $2,750 | | |
| Chevrolet | Chevrolet Motor Co., Flint, Mich | | 4, 24, r, $750<br>4, 24, t, $875 | 6, 30, t,S,E, $1,425 | | | |
| Cole | Cole Motor Car Co., Indianapolis, Ind | | | 4, 29, r,t,c,S,E, $1,485<br>6, 29, r,t,c,S,E, $1,865 | 6, 44, r,t,c,l,S,E, $2,465 | | |
| Coey | Coey Motor Co., Chicago, Ill | 4, 18, r, $425 | | | | | |
| Crane | Crane Motor Car Co., Bayonne, N. J. | | | | | | 6, 46, chassis, $7,500 |
| Crow-Elkhart | Crow Motor Car Co., Elkhart, Ind | | 4, 16, t,S,E, $725<br>4, 26, t,S,E, $1,175 | 4, 29, t,S,E, $1,495 | | | |
| Crawford | Crawford Automobile Co., Hagerstown, Md. | | | 6, 35, t,S,E, $1,850 | | | |
| Crescent | Crescent Motor Co., Cincinnati, Ohio | | | 4, 29, t,S,E, $1,275<br>6, 38, t,S,E, $1,985 | | | |
| Cunningham | Jas. Cunningham, Son & Co., Rochester, N.Y. | | | | | 4, 40, r,t,S,E, $3,500 | 4, 40, l,ld,S,E, $5,000 |
| Davis | George W. Davis Motor Car Co., Richmond, Ind. | | | 4, 38, r,t,S,E, $1,235 | 6, 50, t,S,E, $2,150 | | |
| De Tamble | De Tamble Motors Co., Anderson, Ind | | 4, 24, r,S,E, $795<br>4, 24, t,S,E, $845 | | | | |
| De Soto | De Soto Motor Car Co., Auburn, Ind | 2, 10, r, $325 | | | | | |
| Detroiter | Briggs-Detroiter Co., Detroit, Mich | | 4, 32, r,t,S,E, $985 | | | | |
| Dispatch | Dispatch Motor Car Co., Minneapolis, Minn. | | 4, 30, r, $850 | 4, 30, t,S,E, $1,210 | | | |
| Dodge | Dodge Bros., Detroit, Mich | | 4, 35, t,S,E, $785 | | | | |
| Dodge | Dodge Motor Car Co., Detroit, Mich | 4, 30, r,S,E, $595 | | | | | |
| Dorris | Dorris Motor Car Co., St. Louis, Mo | | | | 4, 48, t,S,E, $2,200 | 4, 48, l,S,E, $3,400 | |
| Empire | Empire Automobile Co., Indianapolis, Ind | | 4, 32, r,t,S,E, $975 | | | | |
| Enger | Enger Motor Car Co., Cincinnati, Ohio | | | 6, 50, r,t,l,S,E, $1,495 | | | |
| Franklin | H. H. Franklin Manf. Co., Syracuse, N. Y. | | | | 6, 30, r,t,S,E, $2,150<br>6, 30, s,S,E, $3,000 | | |
| Ford | Ford Motor Co., Detroit, Mich | 4, 20, r,E, $440<br>4, 20, t,E, $490 | 4, 20, c,E, $750<br>4, 20, s,E, $975 | | | | |
| Fiat | F. I. A. T., Poughkeepsie, N. Y | | | | | | 4, 55, r,t,S,E, $4,650<br>6, 50, r,t,S,E, $5,150 |
| Firestone-Columbus | New Columbus Buggy Co., Columbus, Ohio | | | 4, 35, r,t,c,S,E, $1,850 | 6, 60, r,t,l,S,E, $2,600 | | |
| Fischer | C. J. Fischer Co., Detroit, Mich | 4, —, r,t,S,E, $595 | 4, —, s,S,E, $845 | | | | |
| Gary | Gary Automobile Mfg. Co., Gary, Ind | | | | 6, 34, t,S,E, $2,350 | | |
| Glide | Bartholomew Co., Peoria, Ill | | 4, 30, t,S,E, $1,195 | | | | |
| Grant | Grant Motor Co., Findlay, Ohio | 4, 21, r,t,l,S,E, $505 | 6, 36, r,t,l,S,E, $795 | | | | |
| Great Western | Great Western Auto Co., Peru, Ind | | | 4, 40, r,t,S,E, $1,710 | | | |
| Haynes | Haynes Automobile Co., Kokomo, Ind | | | 6, 55, r,t,S,E, $1,485<br>6, 55, c,S,E, $1,750 | | | |
| Herff-Brooks | Herff-Brooks Corporation, Indianapolis, Ind. | | 4, 40, t,S,E, $1,100 | 6, 50, r,t,S,E, $1,375 | | | |
| Herreshoff | Herreshoff Light Car Co., Troy, N. Y | 4, 10, r,S,E, $500 | | | | | |
| Holly | Holly Motor Co., Mt. Holly, N. J. | | | | 6, 45, t,S,E, $2,750 | | |
| Hudson | Hudson Motor Car Co., Detroit, Mich | | | 6, 40, r,p,S,E, $1,550 | 6, 40, l,S,E, $2,550 | | |
| Hupmobile | Hupp Motor Car Co., Detroit, Mich | | 4, 36, r,t,S,E, $1,200 | 4, 36, c,s,S,E, $1,325 | | | |
| Imperial | Imperial Automobile Co., Jackson, Mich | | 4, 36, t,S,E, $1,085 | | 6, 50, t,S,E, $2,200 | | |
| Inter-State | Inter-State Motor Co., Muncie, Ind | | 4, 30, t,S,E, $1,000 | | | | |
| Jackson | Jackson Automobile Co., Jackson, Mich | | | 4, 45, r,t,S,E, $1,375<br>6, 45, t,S,E, $1,650 | | | |
| Jeffery | Thomas B. Jeffery Co., Kenosha, Wis | | | 4, 38, r,t,s,l,S,E, $1,450<br>6, 42, r,t,s,l,S,E, $1,650 | | | |
| King | King Motor Car Co., Detroit, Mich | | 4, 26, r,t,S,E, $1,165 | | | | |
| Kissel | Kissel Motor Car Co., Hartford, Wis | | | 4, 36, r,t,S,E, $1,450 | 6, 48, r,t,S,E, $2,350 | 6, 60, r,t,S,E, $3,150 | 6, 60, l,S,E, $4,900 |
| Kline-Kar | Kline Motor Car Corporation, Richmond, Va. | | | 6, 42, r,t,S,E, $1,850 | 6, 42, l,S,E, $2,800 | | |
| Knox | Knox Motors Co., Springfield, Mass | | | | | 4, 45, r,t,l,S,E, $3,850 | 6, 46, r,t,l,S,E, $4,500<br>6, 66, r,t,l,S,E, $5,000 |
| Krit | Krit Motor Car Co., Detroit, Mich | | 4, 30, r,t,S,E, $850 | 4, 30, c,S,E, $1,295 | | | |
| Lambert | Buckeye Manufacturing Co., Anderson, Ind. | | 4, 25, r, $950<br>4, 30, t,S,E, $1,200 | 6, 45, t,S,E, $1,375<br>4, 40, t,S,E, $1,450 | | | |
| Lewis Six | L-P-C Motor Co., Racine, Wis | | | 6, 38, t,S,E, $1,600 | | | |
| Lexington | Lexington Howard Co., Connersville, Ind | | | 4, 40, r,t,S,E, $1,375 | 6, 60, t,S,E, $2,575 | | |
| Locomobile | Locomobile Co. of America, Bridgeport, Ct. | | | | | | 6, 38, r,t,S,E, $4,400<br>6, 38, l,S,E, $5,400<br>6, 48, r,t,l,S,E, $5,100 |
| Lozier | Lozier Motor Car Co., Detroit, Mich | | | | 4, 29, r,t,S,E, $2,100 | 6, 36, t,S,E, $3,250 | 6, 36, l,S,E, $4,625 |
| Luverne | Luverne Automobile Co., Luverne, Minn | | | | 6, 60, r,t,S,E, $2,500 | | |
| Lyons-Knight | Lyons-Atlas Co., Indianapolis, Ind | | | | 4, 32, r,t,S,E, $2,900 | 4, 32, s,S,E, $3,900 | 4, 32, l,S,E, $4,300 |
| Marion | Marion Motor Co., Indianapolis, Ind | | | 4, 36, r,t,S,E, $1,650 | 6, 50, r,t,S,E, $2,150 | | |
| Marmon | Nordyke & Marmon Co., Indianapolis, Ind | | | | | 6, 41, r,t,S,E, $3,250 | 6, 48, r,t,S,E, $5,000<br>6, 48, l,S,E, $6,500 |
| Mason | Mason Motor Co., Waterloo, Iowa | | 4, 55, t,S,E, $1,150 | | | | |
| Maxwell | Maxwell Motor Car Co., Detroit, Mich | 4, 25, t, $695<br>4, 25, c, $840 | | | | | |
| McFarlan | McFarlan Motor Co., Connersville, Ind | | | | 6, 38, r,t,S,E, $2,590 | 6, 38, c,S,E, $3,300<br>6, 38, l,S,E, $4,000 | |
| McIntyre | W. H. McIntyre Co., Auburn, Ind | 4, 23, t,S,E, $695 | | 6, 28, t,S,E, $1,275 | | | |
| Metz | Metz Co., Waltham, Mass | 4, 22, r, $495 | | | | | |
| Mitchell | Mitchell-Lewis Motor Co., Racine, Wis | | | 4, 35, r,t,l,S,E, $1,250<br>6, 50, r,t,S,E, $1,895 | 6, 60, t,S,E, $2,350 | | |
| Moline-Knight | Moline Automobile Co., East Moline, Ill | | | | 4, 50, r,t,S,E, $2,500 | 4, 50, l,S,E, $3,800 | |
| Monarch | Monarch Motor Car Co., Detroit, Mich | | | 6, 45, t,S,E, $1,250 | | | |
| Moon | Moon Motor Car Co., St. Louis, Mo | | | 4, 38, t,S,E, $1,350 | 6, 50, t,S,E, $2,250 | | |
| Moyer | H. A. Moyer, Syracuse, N. Y | | | | 4, 32, r,t,S,E, $2,400 | 6, 48, t,S,E, $3,250 | |
| National | National Motor Vehicle Co., Indianapolis, Ind | | | | 6, 55, r,t,S,E, $2,375<br>6, 55, c,S,E, $2,850 | | |
| Norwalk | Norwalk Motor Car Co., Martinsburg, W. Va. | | | 6, 30, r,t,S,E, $1,875 | 6, 60, r,t,S,E, $2,850 | | |
| Oakland | Oakland Motor Car Co., Pontiac, Mich | | 4, 39, r,S,E, $1,100 | 6, 54, t,S,E, $1,685 | | | |
| Oldsmobile | Olds Motor Works, Lansing, Mich | | | 4, 30, r,t,S,E, $1,285 | 6, 50, t,S,E, $2,975 | | |
| Overland | Willys-Overland Co., Toledo, Ohio | | 4, 30, t,S,E, $850<br>4, 35, r,t,S,E, $1,050 | 6, 50, t,S,E, $1,475 | | | |
| Packard | Packard Motor Car Co., Detroit, Mich | | | | | 6, 38, r,p,S,E, $3,750<br>6, 38, t,S,E, $3,850 | 6, 48, t,S,E, $4,850<br>6, 48, l,S,E, $6,100 |
| Paige | Paige-Detroit Motor Car Co., Detroit, Mich | | 4, 36, r,t,S,E, $1,195 | 6, 46, r,t,S,E, $1,395 | | | |
| Partin-Palmer | Partin Manufacturing Co., Chicago, Ill | | 4, 38, t,S,E, $1,075<br>4, 20, r,S | | | | |
| Paterson | W. A. Paterson Co., Flint, Mich | | 4, 32, t,S,E, $1,095 | 6, 48, t,S,E, $1,495 | | | |
| Pathfinder | Motor Car Manufacturing Co. | | | | 6, 50, r,t,S,E, $2,222<br>6, 50, t,l,S,E, $2,997 | | |


TELEGRAMS AND TELEPHONE
The True Test of Tires
VETERAN drivers, beginners and prospective motorists are drawn to the Automobile Show to inspect the many new things in motordom.
The tire problem confronts them all.
Firestone success shows that veterans have settled the question by using Firestone Tires exclusively.
Beginners and "prospectives" would save time, miles of service and money by taking advantage of the experience of older drivers.
Firestone Tires are standard; they have earned for themselves a name that amounts to prestige. This prestige has actual merit to back it.
"Most Miles per Dollar"
This is the true test of tires—the test of quality, design, workmanship—the test that means economy and satisfaction.
All dealers have Firestones—or can get them promptly.
FIRESTONE TIRE AND RUBBER CO.
"America's Largest Exclusive Tire and Rim Makers"
Akron, Ohio—Branches and Dealers Everywhere
Firestone
NON-SKID TIRES
E. F. Seidel

## Which Pleasure Car Fits the Buyer's Purse?—Concluded

| Name of Car | Name and Address of Manufacturer | Under $700 | $700 to $1,200 | $1,201 to $2,000 | $2,001 to $3,000 | $3,001 to $4,000 | Over $4,000 |
|---|---|---|---|---|---|---|---|
| Peerless | Peerless Motor Car Co., Cleveland, Ohio | | | 4, 22, *r,t,l,S,E*, $2,000 | | | 6, 48, *r,t,l,c,S,E*, $5,000 |
| Pierce-Arrow | Pierce-Arrow Motor Car Co., Buffalo, N.Y. | | | | | | {6, 38, *t,S,E*, $4,300<br>6, 48, *t,S,E*, $5,000<br>6, 66, *t,S,E*, $6,000 |
| Pilot | Pilot Motor Car Co., Richmond, Ind | | | 6, 55, *t,S,E*, $1,885 | 6, 75, *r,t,S,E*, $2,885 | | |
| Pratt | ElkhartCarriageandHarnessCo., Elkhart, Ind. | | | {4, 40, *r,t,S,E*, $1,850<br>4, 40, *t,S,E*, $2,000 | 6, 50, *r,t,S,E*, $2,150 | | |
| Premier | Premier Motor Manf. Co., Indianapolis, Ind. | | | | 6, 32, *r,t,S,E*, $2,385 | | |
| Pullman | Pullman Motor Car Co., York, Pa. | | 4, 30, *r,t,S,E*, $740 | | 6, 48, *r,t,S,E*, $2,500 | | |
| Rayfield | Rayfield Motor Co., Chrisman, Ill. | {4, 18, *r,E*, $395<br>4, 18, *r,S,E*, $475 | | | | | |
| R-C-H | R-C-H Corporation, Detroit, Mich. | | 4, 25, *t,S,E*, $900 | | | | |
| Regal | Regal Motor Car Co., Detroit, Mich. | | 4, 39, *r,t,S,E*, $1,085 | | | | |
| Reo | Reo Motor Car Co., Lansing, Mich. | | 4, 35, *t,S,E*, $1,175 | | | | |
| Republic | Republic Motor Car Co., Hamilton, Ohio | | | | 6, 60, *t,S,E*, $2,950 | | |
| Richard | Richard Auto Manf. Co., Cleveland, Ohio | | | | 4, 25, *r,t,l,S,E*, $2,250 | | |
| Richmond | Wayne Works, Richmond, Ind. | | 4, 40, *r,t,S,E*, $1,125 | 6, 50, *r,t,S,E*, $1,375 | | | |
| S. G. V. | S. G. V. Co., Reading, Pa. | | | | 4, 35, *r,t,S,E*, $2,800 | | 4, 40, *l,S,E*, $4,250 |
| Saxon | Saxon Motor Co., Detroit, Mich. | 4, 15, *r,S,E* $465 | | | | | |
| Simplex | Simplex Automobile Co., New Brunswick, N.J. | | | | | | 4, 46, *l,S,E*, $4,500 |
| Singer | Singer Motor Co., Inc., Long Island City, N.Y. | | | | 6, 60, *r,t,S,E*, $2,350 | | |
| Speedwell | Speedwell Motor Car Co., Dayton, Ohio | | | | 6, 41, *r,t,S,E*, $2,850 | | |
| Spenny | Spenny Motor Car Co., Chicago, Ill. | | 4, 30, *r,t,S,E*, $1,075 | | | 6, 60, *t,S,E*, $3,750 | |
| Sphinx | Sphinx Motor Car Co., York, Pa. | 4, 28, *t,S,E* $ 695 | | | | | |
| Spoerer | Carl Spoerer Sons Co., Baltimore, Md. | | | 4, 25, *r,t,S,E*, $2,000 | 4, 40, *r,t,S,E*, $3,000 | | |
| Stearns | F. B. Stearns Co., Cleveland, Ohio | | | 4, 22, *r,t,S,E*, $1,750 | | 4, 29, *r,t,S,E*, $3,750 | 6, 46, *r,t,S,E*, $4,850 |
| Stevens-Duryea | Stevens-Duryea Co., Chicopee Falls, Mass. | | | | | | {6, 46, *r,t,S,E*, $4,550<br>6, 46, *l,S,E*, $5,800<br>6, 48, *l,b,p,S,E*, $6,200 |
| Studebaker | Studebaker Corp., Detroit, Mich | | 4, 20, *r,t,S,E*, $985 | 6, 29, *t,S,E*, $1,385 | | | |
| Stutz | Stutz Motor Car Co., Indianapolis, Ind. | | | {4, 40, *r,S,E*, $1,475<br>6, 50, *r,t,S,E*, $2,000 | | 6, 60, *t,l,S,E*, $3,675 | |
| Thomas | E. R. Thomas Motor Car Co., Buffalo, N.Y. | | | | | 6, 43, *r,t,l,S,E*, $3,250 | |
| Touraine | Touraine Co., Philadelphia, Pa. | | | | | 6, 60, *t,S,E*, $3,250 | 6, 60, *l,S,E*, $4,550 |
| Traveler | Traveler Motor Car Co., Detroit, Mich. | | 4, 17, *t,S,E*, $795 | | | | |
| Velie | Velie Motor Vehicle Co., Moline, Ill. | | | 6, 40, *r,t,S,E*, $1,595 | 6, 50 *r,t,S,E*, $2,015 | | |
| Vulcan | Vulcan Manf. Co., Painesville, Ohio | | 4, 33, *t,S,E*, $912 | | | | |
| Westcott | Westcott Motor Car Co., Richmond, Ind. | | 4, 35, *r,t,S,E*, $1,185 | 6, 50, *r,t,S,E*, $1,585 | | | |
| White | White Co., Cleveland, Ohio | | | | 4, 30, *r,t,s,S,E*, $2,700 | 4, 45, *t,l,ld,S,E*, $3,800 | 6, 60, *t,S,E*, $5,500 |
| Willys-Knight | Garford Co., Elyria, Ohio | | | | 4, 38, *r,t,S,E*, $2,750 | | |
| Winton | Winton Motor Car Co., Cleveland, Ohio | | | | | 6, 48, *r,t,S,E*, $3,250 | |
| Zimmerman | Zimmerman Manufacturing Co., Auburn, Ind. | 2, 16, *r*, $395 | | 6, 50, *t,S,E*, $1,750 | | | |

# Which Electric Pleasure Car Fits the Buyer's Purse?

## A Self-explanatory Table of the 1915 Models of American Pleasure Cars

| Name of Car | Name and Address of Manufacturer | Under $2,500 | $2,500 to $3,000 | Over $3,000. |
|---|---|---|---|---|
| Argo | American Electric Car Company, Saginaw, Mich. | 4p Roadster, $2,350 | 5p Brougham, $2,800 | |
| Baker | Baker Motor Vehicle Co., Cleveland, Ohio | 2p Roadster, $2 300 | 3p Coupe, $2,800 | 4p Brougham, $3,250 |
| Borland | American Electric Car Company, Saginaw, Mich | 2p Roadster, $2,250 | 5p Brougham, $2,550 | 7p Limousine, $5,500 |
| Bailey | S. R. Bailey & Co., Inc., Boston, Mass. | 2p Roadster, $2,325 | 4p Roadster, $2,580 | |
| Beardsley | Beardsley Electric Company, Los Angeles, Cal | | {3p Roadster, $2,500<br>5p Brougham, $3,000 | |
| Broc | American Electric Car Company, Saginaw, Mich | | | {5p Brougham, $3,100<br>5p Brougham, $3,200 |
| Buffalo | Buffalo Electric Vehicle Company, Buffalo, N. Y. | | | 5p Coupe, $3,250 |
| Century | Century Electric Car Co., Detroit, Mich. | | 4p Brougham, $2,650 | 5p Brougham, $3,250 |
| Chicago | Chicago Electric Motor Car Company, Chicago, Ill. | | 4p Lim., $2,600, 5p Lim., $2,800 | |
| Columbus | New Columbus Buggy Company, Columbus, Ohio | 4p Colonial Coupe, $2,350 | {4p Brougham, $2,800<br>5p Brougham, $3,000 | |
| Detroit | Anderson Electric Car Company, Detroit, Mich. | | {3p Cabriolet, $2,650<br>5p Brougham, $3,000 | |
| Flanders | Flanders Electric, Inc., Detroit, Mich. | 4p Coupe, $1,750 | | |
| Fritchle | Fritchle Auto and Battery Company, Denver, Colo. | 2p Torpedo Roadster, $2,400 | 4p Torpedo Roadster, $2,500 | 5p Brougham, $3,600 |
| Grinnell | Grinnell Electric Car Co., Detroit, Mich. | | 4p Brougham, $3,000 | 5p Brougham, $3,400 |
| Ohio | Ohio Electric Car Company, Toledo, Ohio | | {3p Roadster, $2,650<br>4p Coupe, $2,700 | 5p Coupe, $3,200<br>5p Coupe, $3,500 |
| Rauch & Lang | Rauch & Lang Carriage Co., Cleveland, O. | | {2p, Roadster, $2,600<br>4-5p, Brougham, $2,950} | 5p, Coach. $3,200 |
| Ward | Ward Motor Vehicle Company, Mt. Vernon, N. Y. | 4p Coupe, $2,100 | | |
| Waverley | Waverley Company, Indianapolis, Ind. | {3p Roadster-Coupe, $2,000<br>4p Brougham, $2,300 | 4p Brougham, $2,750<br>5p Limousine, $3,000 | |
| Woods | Woods Motor Vehicle Company, Chicago, Ill. | | 4p Brougham, $2,850 | 5p Brougham, $3,100 |

# Business Man's Reference Table of Commercial Vehicles

## The Latest Models of American Gasoline Motor Trucks and Delivery Cars, Arranged According to Tonnage Carrying Capacity

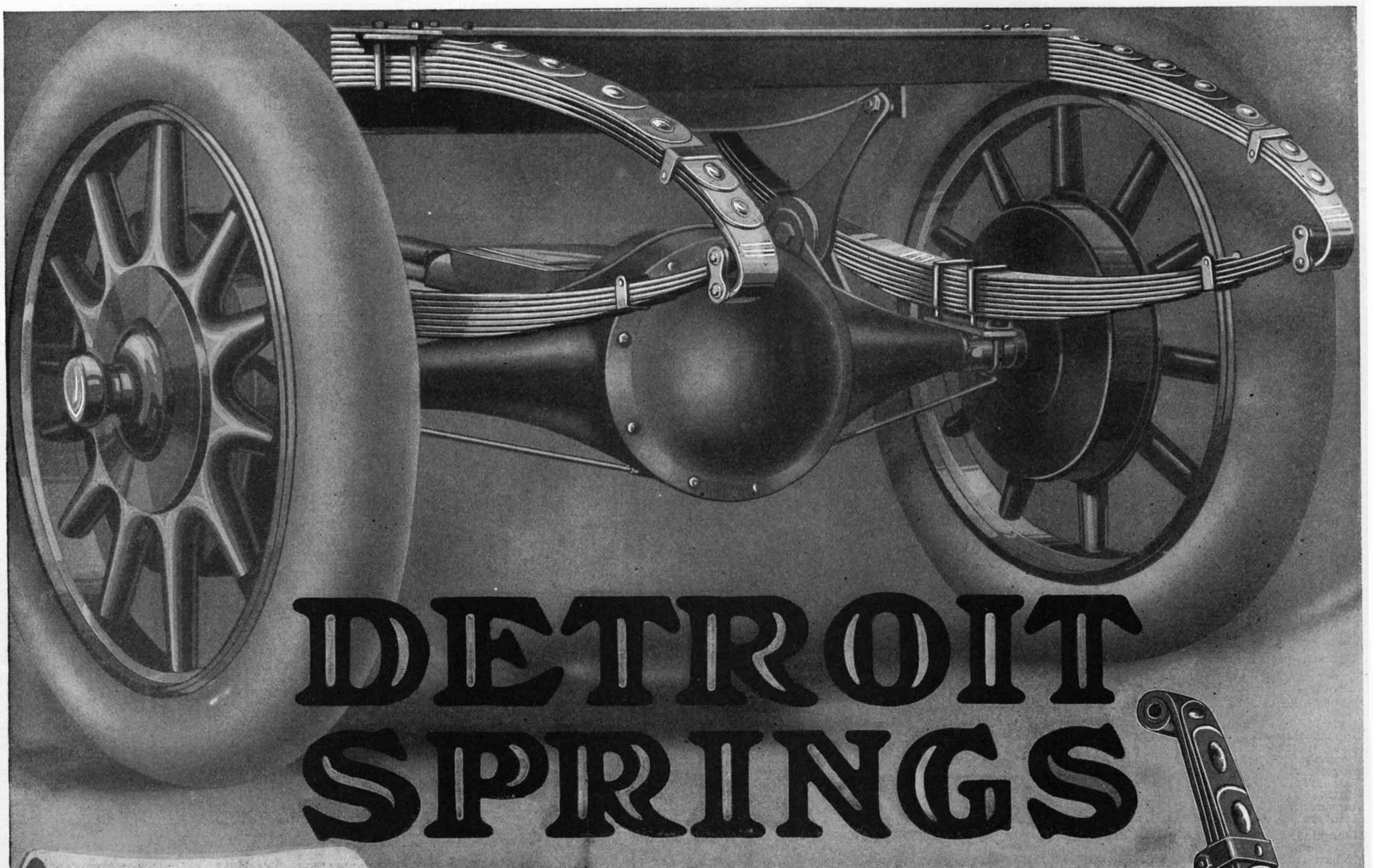
Compiled by C. Edward Palmer

*FOR a business which warrants the purchase of commercial vehicles to haul its goods great care is usually exercised, both by the buyer and the seller, to select a vehicle of the proper horse-power and body capacity for the particular class of goods to be handled. For this reason the business man is usually interested more in the size and capacity of a truck than in its price.*

*In the following table the vehicles are listed alphabetically according to name, and are grouped according to tonnage capacity. In the tonnage columns, the first figure indicates the tons capacity, and the second the horse-power of the truck at the price given. As most manufacturers build bodies to order, to suit the business of the purchaser, the prices given are mostly for chassis only.*

*Motor truck manufacturers have made a careful study of the transportation requirements of many businesses and are glad to co-operate with purchasers in the efficient installation of commercial vehicle service.*

| Name of Vehicle | Name and Address of Manufacturer | Tons Capacity, Horse-power and Price | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Under 1 ton | 1 - 1½ | 2 - 2½ | 3 - 3½ | 4 | 5 | 6 and over |
| Adams | Adams Bros. Co., Findlay, Ohio | | 1, 30, $1,850 | 2, 35, $2,500 | | | | |
| Aetna | Aetna Motor Truck Co., Detroit, Mich. | | 1½, $2,150 | 2½, $2,400 | | | | |
| American Daimler | General Vehicle Co., Inc., Long Island City, N. Y. | | | | | | | 6, 35 |
| Armleder | O. Armleder Co., Cincinnati, Ohio | | 1, 30, $2,200 | 2, 40, $2,150 | | | | |
| Atterbury | Atterbury Motor Car Co., Buffalo, N. Y. | ¾, 25, $1,800 | 1, 30, $2,100 | 2, 40, $2,800 | 3, 50, $3,400 | | 5, 50, $4,000 | |
| Available | Available Truck Co., Chicago, Ill. | | 1, 30 | 2, 40 | | | | |
| Avery | Avery Co., Peoria, Ill. | | 1, 27, $1,690 | 2, 36, $2,700 | 3, 36, $3,200 | | 5, 45, $4,500 | |
| Auglaize | Auglaize Motor Car Co., New Bremen, Ohio | ¾, 28, $950 | 1, 32, $1,200 | | | | | |
| Autocar | Autocar Co., Ardmore, Pa. | | 1½, 18, $1,850 | | | | | |
| Barker Motor Wagon | C. L. Barker, Norwalk, Conn. | | 1, $2,000 | 2, $2,400 | | | | |
| Bessemer | Bessemer Motor Truck Co., Grove City, Pa. | | 1½, 27, $1,800 | 2, 27, $2,300 | | | | |
| Best | Durant-Dort Carriage Co., Flint, Mich. | ½, 16, $750 | | | | | | |
| Blair | Blair Motor Truck Co., Newark, Ohio | | | 2, 35, $2,850 | 3, 40, $3,250 | 4, 40, $3,750 | 5, 40, $4,500 | |
| Brockway | Brockway Motor Truck Co., Cortland, N. Y. | ¾, 20, $1,250 | 1¼, 25, $1,650 | 2, 35, $1,950 | | | | |
| Buick | Buick Motor Co., Flint, Mich. | ¾, 38, $1,150 | | | | | | |
| Bulley Tractor and Mercury Trucks | Mercury Manufacturing Co., Chicago, Ill. | ½, 14, $750 | 1½, 30, $3,400 | | | | | |
| Cass and Independent | Independent Motors Co., Port Huron, Mich. | ¾, 23, $1,285 | 1½, 27, $1,850 | | | | | |
| Champion | Famous Manufacturing Co., East Chicago, Ind. | | 1, 24, $750 | 2, 35, $1,250 | 3, 45, $1,750 | | | |
| Chase | Chase Motor Truck Co., Syracuse, N. Y. | ½, 15, $750 | 1½, 30, $2,200 | | 3, 40, $3,300 | | | |
| Clark | Clark Delivery Car Co., Chicago, Ill. | | 1½, 30, $1,800 | | | | | |
| Coleman | F. Coleman Carriage and Harness Co., Ilion, N. Y. | | 1, 23, $2,100 | 2, 23, $2,550 | 3, 27, $3,150 | | | |
| Commer | Commercial Cars, Ltd., New York City | | | | 3, 30, $3,500 | 4, 35, $4,000 | 5, 40, $4,500 | 7, 45, $5,000 |
| Commerce | Commerce Motor Car Co., Detroit, Mich. | ¾, $975 | | | | | | |
| Corbitt | Corbitt Automobile Co., Henderson, N. C. | | 1¼, 35, $2,000 | 2, 40, $2,300 | | | | |
| Couple Gear | Couple Gear Freight Wheel Co., Grand Rapids, Mich. | | | | | 4, 45, $5,000 | | {6, 55, $5,600<br>12, 70, $6,500 |


DETROIT
SPRINGS

## A Business Man's Reference Table of Commercial Vehicles.—Concluded

| Name of Vehicle | Name and Address of Manufacturer | Tons Capacity, Horse-power and Price: Under 1 ton | 1 - 1½ | 2 - 2½ | 3 - 3½ | 4 | 5 | 6 and over |
|---|---|---|---|---|---|---|---|---|
| Croce | Croce Automobile Co., Asbury Park, N. J | ¾, 22, $1,800 | 1, 28, $1,850 | 2, 30, $2,600 | 3, 36, $3,600 | | | |
| Crown | Crown Commercial Car Co., North Milwaukee, Wis | | 1, 28, $2,000 | 2, 35, $2,500 | 3, 40, $3,000 | | | |
| Duplex Four-wheel Drive | Duplex Power Car Co., Charlotte, Mich | | | 2, 32, $2,800 | 3, 40, $3,200 | | | |
| Dorris | Dorris Motor Car Co., St. Louis, Mo | ¾, 48, $1,950 | | 2, 48, $2,500 | | | | |
| Doyle | J. C. Doyle, Seattle, Wash | | 1½,30,$1,750 | | 3, 50, $2,750 | | | 10, 90, $4,750 |
| Diamond T | Diamond T Motor Car Co., Chicago, Ill | ¾,25,$2,000 | 1½,30,2,250 | 2, 30, $2,500 | 3, 40, $3,600 | | | |
| Dispatch | Dispatch Motor Car Co., Minneapolis, Minn | ½, 30, $900 | | | | | | |
| Denby | Denby Motor Truck Co., Detroit, Mich | ¾, 20, | 1, 20, | | | | | |
| Delahunty | Delahunty Dyeing Machine Co., Pittston, Pa | | 1½,30,$1,800 | | | | | |
| Dart | Dart Motor Truck Co., Waterloo, Ia | ½, 20, $875 | 1, 24, $1,400 | 2, 35, $1,800 | | | | |
| Durable Dayton | Durable Dayton Truck Co., Dayton, Ohio | | | 2, 36, $1,800 | 3, 45, $2,250 | 4, 45, $2,700 | 5, 60, $3,100 | 6, 60, $3,500 |
| Fargo | Fargo Motor Car Co., Chicago, Ill | | 1, 23, $1,250 | | | | | |
| Four-Wheel Drive | Four-Wheel Drive Auto Co., Clintonville, Wis | | | 2, 29, $3,600 | 3, 36, $4,000 | | | 6, 44, $4,800 |
| Federal | Federal Motor Truck Co., Detroit, Mich | | 1½,30,$1,800 | | | | | |
| Flint | Durant-Dort Carriage Co., Flint, Mich | | 1, 23, $1,190 | | | | | |
| Fremont-Mais | Lauth-Juergens Motor Car Co., Fremont, Ohio | | 1½,30,$1,700 | | | | | |
| G. M. C | General Motors Truck Co., Pontiac, Mich | ¾, 20, $1,090 | 1¼,20,$1,500 | 2, 26, $1,900 | 3½,40,$2,500 | | 5, 40, $3,000 | |
| Gabriel | Gabriel Auto Co., Cleveland, Ohio | ½,22,$1,000<br>¾,28,$1,600 | 1,30,$2,000<br>1½,35,$2,400 | | | | | |
| Garford | Garford Co., Elyria, Ohio | | | 2, 29, $3,000 | 3, 29, $3,500 | 4, 29, $3,850 | 5, 29, $4,500 | 6, 29, $4,850 |
| Gay | S. G. Gay Co., Ottawa, Ill | ¾, 25, $1,500 | 1½,30,$1,700 | | | | | |
| B. A. Gramm | Gramm-Bernstein Co., Lima, Ohio | ¾, $1,500 | 1½, $1,800 | 2, $2,600 | 3½, $3,500 | | | 6, $4,300 |
| Hahn | Hahn Motor Truck and Wagon Co., Hamburg, Pa | | 1, 30, | 2, 40, | 3, 45, | | | |
| Handy Wagon | Auburn Motor Chasis Co., Auburn, Ind | ¼, 11, $295<br>⅗, 18, $575 | | | | | | |
| Harvey | Harvey Motor Truck Works, Harvey, Ill | | 1½,30,$1,800 | | 3, 40, $3,000 | | | |
| Hendrickson | Hendrickson Motor Truck Co., Chicago, Ill | | 1½,30,$1,550 | 2, 30, $1,850 | 3, 35, $2,400 | 4, 45, $3,400 | | |
| Horner | Detroit-Wyandotte Motor Co., Wyandotte, Mich | | 1, 33, $2,000 | 2, 33, $2,650 | 3, 36, $3,200 | | 5, 46, $4,200 | |
| Hupmobile | Hupp Motor Car Co., Detroit, Mich | ⅖, 32, $1,050 | | | | | | |
| Hurlburt | Hurlburt Motor Truck Co., New York City | | 1, 22, $1,500 | 2, 28, $3,000 | 3½,32,$3,500 | | | |
| Ideal | Ideal Auto Co., Fort Wayne, Ind | | 1½,35,$2,000 | | | | | |
| Interboro | Interboro Motor Truck Co., Philadelhpia, Pa | | 1, 23, $1,850 | | | | | |
| International | International Harvester Corp., Chicago, Ill | ½, 20, | | | | | | |
| Jeffery | Thomas B. Jeffery Co., Kenosha, Wis | ¾, 38, $1,300 | 1, 35, $1,500 | 2, 38, $2,750 | | | | |
| Kalamazoo | Kalamazoo Motor Vehicle Co., Kalamazoo, Mich | | 1½,30,$1,590 | | | | | |
| Kelley-Springfield | Kelley-Springfield Motor Truck Co., Springfield, Ohio | | 1, 30, $2,000 | 2, 30, $2,750 | 3½,40,$3,400 | 4, 40, $3,685 | 5, 40, $4,250 | 6, 40, $4,550 |
| King | A. R. King Manufacturing Co., Kingston, N. Y | | | | 3½,32,$3,350 | | | |
| Kissel Kar | Kissel Motor Car Co., Hartford, Wis | ¾, 36, $1,500 | 1, 36, $1,850 | 2½,40,$2,750 | 3½,40,$3,350 | | | 6, 50, $4,350 |
| Knickerbocker | Knickerbocker Motor Truck Manufacturing Co., New York City | | | | 3½,40,$3,750 | 4, 40, $4,000 | 5, 40, $4,500 | |
| Knox Tractor | Knox Motor Co., Springfield, Mass | | | | | | 5, 40, $3,250 | 10, 40,$3,750 |
| Koehler | H. J. Koehler Sporting Goods Co., Newark, N. J | | 1, 24, $750 | | | | | |
| Kopp | Kopp Motor Truck Co., Buffalo, N. Y | | | 2, 30, | 3½, 38, | | | 6, 49, |
| Kosmath | Kosmath Co., Detroit, Mich | ½, 18, $700<br>¾, 22, $960 | | | | | | |
| Krebs | Krebs Commercial Car Co., Clyde, Ohio | ¾, 23, $1,450 | 1, 23, $1,900 | 2, 28, $2,350 | | | | |
| LaFrance-Hydraulic | American LaFrance Fire Engine Co., Inc., Elmira, N. Y | | | | | | | 6¼,48,$5,500 |
| Lambert | Buckeye Manufacturing Co., Anderson, Ind | ⅖, 25, $950 | 1½,35,$1,900 | 2, 40, $2,300 | | | | |
| Lange | Lange Motor Truck Co., Pittsburg, Pa | | 1½,23,$2,250 | 2½,27,$3,000 | | | | |
| Lewis | Lewis Motor Truck Co., Inc., Oakland, Cal | | | 2½,35,$2,900 | 3, 35, $3,250 | | 5, 50, $4,400 | 6, 50, $4,500 |
| Lippard-Stewart | Lippard-Stewart Motor Car Co., Buffalo, N. Y | ¾, 30, $1,650 | 1, 30, $2,000 | 2, 35, $2,600 | | | | |
| Little Giant | Chicago Pneumatic Tool Co., Chicago, Ill | | 1, 25, $1,350 | | | | | |
| Locomobile | Locomobile Company of America, Bridgeport, Conn | | | | 3, 30, $3,500 | 4, 30, $3,650 | 5, 40, $4,500 | 6, 40, $4,800 |
| Longest | Longest Brothers Co., Louisville, Ky | | | | | 4, 40, $4,000 | | 6, 40, $4,500 |
| Mais | Mais Motor Truck Co., Indianapolis, Ind | | 1½,40,$2,750 | 2, 40, $2,950 | 3, 45, $3,400 | | | |
| Martin | Martin Carriage Works, Inc., York, Pa | | 1½,30,$2,150 | 2½,35,$2,850 | 3½,50,$3,500 | | | |
| Mansur | Mansur Motor Truck Co., Haverhill, Mass | | 1½,30,$2,300 | | 3, 35, $3,000 | | | |
| McIntyre | W. H. McIntyre Co., Auburn, Ind | | 1½,28,$2,300 | 2, 28, $2 800 | 3, 28, $3,200 | | | |
| Menominee | D. F. Poyer Co., Menominee, Mich | ¾, 25, $1,125 | 1, 35, $1,400<br>1½,35,1,800 | | | | | |
| Modern | Bowling Green Motor Truck Co., Bowling Green, Ohio | | 1, 27, $1,750<br>1½,32,1,950 | 2, 36, $2,300 | | | | |
| Moore | Pacific Metal Products Co., Torrence, Cal | | | 2, 32, $2,500 | | | 5, 44, $4,500 | |
| Moreland | Moreland Motor Truck Co., Los Angeles, Cal | ¾, 23, $1,800 | 1½,27,$2,050 | 2½,34,$2,650 | 3½,34,$3,350 | | 5, 34, $4,000 | 6½,44,$4,500 |
| Natco | National Motor Truck Co., Bay City, Mich | | 1, 25, $1,925 | | | | | |
| Nelson & LeMoon | Nelson & LeMoon, Chicago, Ill | | 1, 30, $1,800 | 2, 35, $2,250 | 3, 40, $2,750 | | | |
| New York | Tegetmeier & Riepe Co., New York City | | 1½,32,$1,800 | | | | | |
| Old Hickory | Kentucky Wagon Mfg. Co., Louisville, Ky | | 1½, $2,000 | | | | | |
| Old Reliable | Old Reliable Motor Truck Co., Chicago, Ill | | 1½,25,$2,250 | 2, 35, $2,750 | 3, 35, $3,400 | 4, 45, $4,000 | 5, 45, $4,500 | 7, 50, $6,000 |
| Overland | Willys Overland Co., Toledo, Ohio | ⅖, 30, $850 | | | | | | |
| Packard | Packard Motor Car Co., Detroit, Mich | | | 2, 26, $2,000 | 3, 32, $3,400 | | 5, 40, $4,150 | |
| Palmer | Palmer-Meyer Motor Car Co., St. Louis, Mo | | 1, 30, $1,600 | 2, 35, $2,250 | | | | |
| Palmer-Moore | Palmer-Moore Co., Syracuse, N. Y | | 1, 32, $1,350 | | | | | |
| Peerless | Peerless Motor Car Co., Cleveland, Ohio | | | | 3, 33, $3,750 | 4, 33, $4,000 | 5, 33, $4,500 | 6, 33, $5,000 |
| Pierce Arrow | Pierce Arrow Motor Car Co., Buffalo, N. Y | | | 2, 26, $3,000 | | | 5, 38, $4,500 | |
| Reo | Reo Motor Truck Co., Lansing, Mich | | | 2, 27, | | | | |
| Republic | Republic Motor Truck Co., Alma, Mich | ¾, 25, $995 | 1,35,$1,350<br>1½,35,1,475 | | | | | |
| Robinson | Robinson Motor Truck Co., Minneapolis, Minn | | | 2, 36, $2,500 | 3½,45,$3,400 | | 5, 50, $3,800 | |
| Roland | Roland Gas-Electric Vehicle Co., New York City | | 1½,30,$2,000 | | 3½,45,$3,500 | | | |
| Rowe | Rowe Motor Manufacturing Co., Downingtown, Pa | | 1½,32,$2,450 | 2, 40, $2,800 | 3, 48, $3,400 | | 5, 48, $4,500 | |
| Royal | Royal Motor Truck Company of New York, Brooklyn, N. Y | | | | 3½,36,$3,400 | | 5, 40, $4,500 | |
| Sandow | Sandow Truck Co., Chicago, Ill | | 1, 30, $1,800 | 2, 35, $2,350 | 3, 45, $3,000 | 4, 45, $3,600 | | |
| Sanford | Sanford Motor Truck Co., Syracuse, N. Y | | | 2, 26, $2,000 | | | | |
| Schacht | G. A. Schacht Motor Truck Co., Cincinnati, Ohio | | | 2, 40, $2,800 | 3, 40, $3,200 | | | |
| Selden | Selden Motor Vehicle Co., Rochester, N. Y | | 1½,20,$2,000 | | | | | |
| Service | Service Motor Truck Co., Wabash, Ind | | 1, 22, $2,000 | 2, 27, $2,500 | 3, 30, $2,975 | | 5, 40, $4,000 | |
| Siebert | The Shop of Siebert, Toledo, Ohio | ¾, 22, $1,250 | | | | | | |
| Signal | Signal Motor Truck Co., Detroit, Mich | | 1, 23, $1,400<br>1½,23,1,700 | | | | | |
| Smith | A. O. Smith Co., Milwaukee, Wis | | | | 3, $3,500 | 4, $3,750 | | 6, $4,750 |
| South Bend | South Bend Motor Car Works, South Bend, Ind | | 1½,30,$1,750 | 2, 40, $1,850 | 3, 80, $2,850 | | 5, 95, $3,250 | 10,120,$5,000 |
| Speedwell | Speedwell Motor Car Co., Dayton, Ohio | | | 2, 30, $2,850 | | 4, 50, $3,850 | | 6, 50, $4,500 |
| Standard | Standard Motor Truck Co., Detroit, Mich | | | | 3, 45, $2,750 | | 5, 45, $3,300 | |
| Steele | W. M. Steele, Worcester, Mass | | | 2, 30, $2,500 | 3, 40, $3,000 | 4, 40, $3,500 | 5, 40, $4,000 | |
| Stegeman | Stegeman Motor Car Co., Milwaukee, Wis | ¾, 30, $1,600 | 1½,30,$2,100 | 2½,35,$2,800 | 3½,45,$3,350 | | 5, 50, $4,200 | |
| Sterling | Sterling Motor Truck Co., Milwaukee, Wis | ½, 20, $850 | | 2, 23, $2,800 | 3, 29, $3,400 | | 5, 37, $4,500 | 7, 40, $4,750 |
| Stewart | Stewart Motor Corporation, Buffalo, N. Y | ¾, 30, $1,500 | | | | | | |
| Studebaker | Studebaker Corporation of America, Detroit, Mich | ¾, $985 | | | | | | |
| Sullivan | Sullivan Motor Car Co., Rochester, N. Y | | 1½,25,$1,600 | | | | | |
| Tiffin | Tiffin Wagon Co., Tiffin, Ohio | ¾, 25, $1,600 | 1, 30, $2,000 | 2, 35, $2,700 | | | | |
| Transit | Transit Motor Truck Co., Louisville, Ky | | 1, 30, $2,000 | 2, 35, $2,850 | 3½,45,$3,500 | | 5, 45, $4,500 | |
| Twin City | Brasie Motor Car Co., Minneapolis, Minn | ½, 16, $450 | | 2, 30, $1,350 | | | | |
| Velie | Velie Motor Vehicle Co., Moline, Ill | | 1, 40, $2,000 | 2½,45,$2,850 | | 4, 45, $3,350 | 5, 45, $3,750 | |
| Victor | Clover Leaf Milling Co., Buffalo, N. Y | | 1½,30,$2,250 | | 3, 40, $3,400 | | 5, 50, $3,850 | |
| Vim | Touraine Co., Philadelphia, Pa | ½, 20, $620 | | | | | | |
| Vixen | Davis Manufacturing Co., Milwaukee, Wis | ⅕, 14, $395 | | | | | | |
| Vulcan | Driggs-Seabury Ordnance Corporation, Sharon, Pa | | | 2, 30, $2,750 | 3, 30, $3,250 | 4, 30, $4,000 | 5, 30, $4,500 | 7, 30, $6,000 |
| Wade | Wade Commercial Car Co., Holly, Mich | ½, 10, $300 | | | | | | |
| Walter (Truck & Tractor) | Walter Motor Truck Co., New York City | | | | | | 5, 40, $4,500 | 12, 40,$4,500 |
| White | White Company, Cleveland, Ohio | ¾, 30, $2,250 | 1½,30,$3,150 | | 3, 30, $3,850 | | 5, 40, $4,700 | |
| Wichita | Wichita Falls Motor Co., Wichita Falls, Tex | | 1, 30, $1,650 | 2, 35, $2,100 | 3½,50,$3,250 | | | |
| Wilcox Trux | H. E. Wilcox Motor Co., Minneapolis, Minn | ½, 28, $1,000 | 1, 30, $2,000 | 2, 35, $2,500 | 3, 40, $3,250 | | | |
| Willet | Willet Engine and Truck Co., Inc., Buffalo, N. Y | ¾, 30, $1,600 | 1, 30, $1,850 | 2, 35, $2,600 | 3, 40, $2,800 | | | |
| Willys-Utility | Gramm Motor Truck Co., Lima, Ohio | ¾, 30, $1,350 | | | | | | |
| Wisconsin | Wisconsin Motor Truck Works, Baraboo, Wis | ¾, 30, $1,500 | 1½,35,$1,700 | 2, 40, $2,000 | | | | |

# Reference Table of Electric Commercial Vehicles

*In the tonnage columns of the following table, the first figure indicates the tons capacity of the truck at the price given. As in the Gasoline Commercial Vehicle list, the prices are mostly for chassis only. Bodies are constructed to order, to suit the class of goods to be handled.*

| Name of Vehicle | Name and Address of Manufacturer | Tons Capacity and Price: Under 1 ton | 1 - 1½ | 2 - 2½ | 3 - 3½ | 4 | 5 | 6 and over |
|---|---|---|---|---|---|---|---|---|
| American-Argo | American Electric Car Co., Saginaw, Mich | ½, $1,575 | 1, $1,720 | | | | | |
| Baker | Baker Motor Vehicle Co., Cleveland, O | ½, $1,900 | 1, $2,300 | 2, $2,800 | 3½, $3,500 | | 5, $3,850 | |
| Buffalo | Buffalo Electric Vehicle Co., Buffalo, N. Y | | 1, $2,400 | | | | | |
| Couple Gear | Couple Gear Freight Wheel Co., Grand Rapids, Mich | (Front<br>(Four | wheel Driv<br>wheel Driv | e)<br>e) | 3, $3,500<br>3½, $4,400 | | 5, $4,000<br>5, $5,000 | |
| C. T | Commercial Truck Company of America, Philadelphia, Pa | ½, $1,640 | 1, $2,095 | 2, $2,725 | 3½, $3,530 | | 5, $3,935 | 7, $4,435 |
| Detroit | Anderson Electric Car Co., Detroit, Mich | | | 2, $2,200 | | | | |
| Doyle | J. C. Doyle, Seattle, Wash | | 1½, $2,350 | | | | | |
| Eldridge | Eldridge Manufacturing Co., Boston, Mass | | | 2, $3,000 | 3, $3,250 | 4, $3,500 | 5, $3,750 | 6, $3,950 |
| Electruck | Los Angeles Creamery Auto and Machine Works, Los Angeles, Cal | ¾, $2,900 | (Special body | for milk deli | very.) | | | |
| G. M. C | General Motors Truck Co., Pontiac, Mich | ½, $1,200 | 1, $1,300 | 2, $1,650 | 3, $1,900 | 4, $2,100 | 5, $2,350 | 6, $2,500 |
| G. V | General Vehicle Co., Long Island City, N. Y | ½, $1,700 | 1, $2,100 | 2, $2,600 | 3½, $3,250 | | 5, $3,700 | |
| Old Hickory | Kentucky Wagon Mfg. Co., Louisville, Ky | | 1, $2,000 | | | | | |
| Roland | Roland Gas-Electric Vehicle Corporation, New York City | | 1, $2,000 | | 3, 3½, $3,500 | | | |
| S. G. S | S. G. Schorpflin Co., Buffalo, N. Y | ¾, $1,600 | | | | | | |
| Urban | Kentucky Wagon Mfg. Co., Louisville, Ky | ¾, $1,560 | 1½, $1,920 | 2½, $2,530 | | 4, $3,080 | | |
| Walker | Walker Vehicle Co., Chicago, Ill | ½, | 1, | 2, | 3, | 4, | | |
| Ward | Ward Motor Vehicle Co., Mt. Vernon, N. Y | ⅜, $875<br>½, $1,250 | 1, $1,500 | 2, $1,900 | 3½, $2,450 | | 5, $2,950 | |
| Waverley | Waverley Co., Indianapolis, Ind | ½, $1,800 | 1, $2,150 | 2, $3,000 | 3½, $3,400 | | 5, $3,950 | |

### Burton Process of "Cracking" to Make Gasoline

(*Concluded from page 5.*)

Mr. Burton puts his valve *beyond* the condenser, so that pressure is applied not only to the liquids in the still but to the gases condensing in the coil.

In using the apparatus, there is introduced into the still a quantity of the residual portion of the paraffine series of petroleum distillation—let us say the distillate known as fuel oil, which has a boiling point of upward of 500 deg. Fahr. The valve is normally closed. Heat from the fire-chamber distills the volatile constituents and the resultant vapor courses through the pipe and soil, in which they are condensed. With the valve tightly closed against the escape of the products of condensation, the vapors of distillation accumulate and exert a high pressure, from 4 to 5 atmospheres, upon the liquid in the still, raising the boiling point from 500 or 600 deg. Fahr. to 700-800 deg. Fahr. This pressure of the vapors combined with their contained heat converts high boiling members of the paraffine series into low boiling members of the same series. The valve is opened from time to time to draw off the products of condensation into the receiver. The intervals of drawing off are sufficiently frequent to avoid filling the coil with liquid. In the meantime the relief valve is occasionally opened to relieve gas pressure near the lower end of the coil, which is otherwise likely to obstruct operations.

The resultant gasoline is a product belonging to the paraffine series, the same as the petroleum residue from which it was distilled. Mr. Burton makes no attempt to account for the effect of the back pressure from the extreme end of the condensed coil upon the contents of the holder in preventing transformation of the paraffine series into the objectionable ethylene series, but it is the fact that such effect ensues.

This method of distillation is continued until what is left is a thin, syrup-like residue, marking the limit of the Burton process when first patented. It has, however, been greatly improved since then. In the recently perfected process the residue is taken to a second still of ordinary construction, there to be subjected to heat at approximately atmospheric pressure until nothing is left in the still but a solid residue. The liquid product of this distillation is reintroduced into the first still, mixed with a new charge of the original fuel oil character, there to be again distilled under pressure.

The yields of finished gasoline that can be obtained by this process vary widely with the character of the so-called fuel oil, which is used as a raw material. Oils derived from crude oil from one section of the world give much better results than oils derived from other sections. Some oils will give a yield of around 60 per cent of crude gasoline distillate, while others will not give so much.

The oil secured by redistilling the products from the original distillation are more refractory than what might be called "fresh" stock. It is therefore impossible to give definite figures as regards yields, but in a broad, general way it might be stated that the process in question will at least double the yield of finished gasoline products from a given crude oil.

It should be understood that the gasoline distillate thus produced, while usable in internal combustion engines, is not a deodorized product. To render it such requires redistillation and sulphuric acid treatments.

It is perhaps too early to say what this process will mean to the commercial world or how it will affect the prices of gasoline. Mr. Burton's first patent on this process was issued January 7th, 1913, and the second, making use of the 35 per cent residue from the first "cracking," was issued August 4th, 1914. The fact that the Standard Oil Company is using the process in a plant built for the purpose is evidence of its commercial and practical utility as well as of its scientific interest. Logically, if the process itself is as cheap and economical as it appears to be, the coming increase of consumption of gasoline, by the thousands of new automobiles and other calls for "motor spirit," is already met with a means for making several cobblestones out of one rock—several gallons of gasoline where only one grew before.

### Military Tactics and the Motor

(*Concluded from page 9.*)

and miles in the rear of the battle line, as far beyond the range of heavy artillery fire as possible. Connection with the firing line is maintained by telephone and by motorcycle dispatch riders. In fact, the latter are pressing the automobiles hard for honors in this field.

It is getting dark. A fog seems to settle over the battlefield, the smoke from burning farm houses, haystacks, and—well, and "other things"—hangs like a pall over everything. Suddenly a sputtering motorcycle flashes past at a speed of more than a mile a minute. In the continuous crackling of small guns and rifles the noise of the racing motorcycle is almost lost. Peering with eyes strained to the point of tears into the dim light ahead, his sharp electric horn screeching an alarm forward, the rider flashes by, at every instant of his ride flirting with death, because of the darkness ahead. Suddenly he shuts off the gas and slams down the brake with all his power. He just manages to stop as his front wheel touches the rear of a convoy truck going slowly to the rear. Past the truck, ordering the driver to stick farther to the right of the road, he goes, and soon he finds "his" truck detachment. An order to the driver in charge, and the whole convoy starts for the battle lines. The motorcyclist acts as guide, so as to insure quick delivery of the ammunition needed at such and such a place. Each regiment has one or two such dispatch riders ready at all times. They sometimes get no real rest for days at a time, snatching a bit of sleep after having fetched one convoy to the point needed.

The ammunition column thunders past the watcher on the roadside. Powerful gasoline trucks, driven without any regard to efficiency or economy of operation—solely with the idea of getting there, and getting there as quick as the roads will permit. Hardly has the column reached its destination when an urgent request is received by the commanding general for reinforcements to a certain danger point. The telephone carries the message to a motor column in the rear, and fifty motor buses, tractors with two and three trailers, all loaded to capacity, rush forward. Three additional regiments reach the point of danger within a fraction of the time it would have taken an old-fashioned "orderly" to gallop to the commanding general on the well-known "hill overlooking the battlefield." The "hill" in this case happens to be a captive balloon fully 3,000 feet above the trenches.

A lull in the bombardment. Wounded are picked up by the sanitary corps and carried to certain collection points in the rear of the trenches. Every little while motor ambulances call at these points and carry away those whom it has been possible to save under the artillery attack. The motor ambulances, in the case of the French armies, go back to cities in which facilities for the treatment of the wounded can be found, while in the case of the German armies well equipped hospital trains of twenty-five to thirty coaches wait at some convenient gathering point behind the battle line, to which point the motor ambulances carry their loads.

**Steam Tractors.**

One of the surprises of the British expeditionary forces has been the excellent showing of the fleet of 110 Foden steam trucks as heavy tractors. For slow haulage of three and more trailers, of heavy artillery, and as repair wagons with complete electrical equipment, these steam trucks have given invaluable service. They are easily kept in repair and they burn small anthracite coal as well as crude oil and kerosene. In the first batch of steam trucks there was considerable difficulty about fuel, and a whole column came near being wrecked because of the

dense columns of smoke given off by the steam wagons. The German artillery, more than seven miles away, got the range of the smoke column and big shells dropped amid the convoy, wrecking three of the Fodens and damaging others severely before the trouble with the fuel could be remedied. Besides the big fleet of 110 Fodens, there are about 80 other steam trucks, of four different makes, in use behind the battle lines. For slow, heavy tractor work the steamers are preferred to the 50 and 100 horse-power gasoline trucks. Generally a complete fleet of steam wagons consists of about thirty vehicles, including a few trailers, a repair wagon, a 1,000-gallon water tank wagon with high speed pump installation, stores and equipment sufficient to make the entire fleet self-sustaining for six months under war conditions. The personnel of such a fleet consists of one officer, sixteen non-commissioned officers, sixty drivers, five mechanics, two boilermakers, two smiths, two wheelwrights, two motorcycle orderlies, and one cook.

The driver of one of the heavy trucks, in a letter to his folk, complains that he never knows where he is going. He says that a motorcyclist precedes the first truck of a column, and the driver of that truck has orders to follow the cyclist. The other drivers, of course, "follow the leader." On one occasion the whole convoy made a rush trip which lasted, with few stops, three whole days.

### Signal Troubles.

The old-fashioned signal "halt" called by a sentry on the roadside probably will have to be amended in some way. On numerous occasions drivers of motor trucks, motorcycles and swift touring cars have dodged death by a hair's breadth. A dozen or so are reported to have been killed because of the old-fashioned "halt" shouted by a soldier. The sputtering motor downs the call, and the first intimation the driver of a car gets that anything is wrong is a rifle bullet singing past his head. Complaints from drivers have caused a change in the challenging along some of the most frequently used roads. A red lantern is waved, and if the driver does not stop instantly there's apt to be a vacancy on that particular truck.

### Far-reaching Accidents.

On what slight chances the safety of a whole army sometimes depends was shown in the early part of September during a retreat of a French division to another fortified position. There was only a single road of medium width, along which the swift retreat was made. A desperate attack of the Germans in greatly superior numbers was launched at this point, and the whole division took to the motors for rapid withdrawal. At the high speed made, one of the big trucks near the head of the column skidded and upset, pitching its load of heavy cases of ammunition into the road and blocking it completely for all vehicles. It took forty-five minutes to clear the *débris*, and in that time the German artillery dropped hundreds of shells into the surging mass on the road. Fourteen heavy trucks had to be abandoned, after having been rendered useless by removal of important parts. Almost a thousand men were killed and three times that number wounded—all because a truck skidded at the wrong time!

In another case reported from Belgium, a motorcycle orderly guiding an ammunition train to its destination was struck by a small piece of shrapnel in such a manner as to make him lose control of the wheel. He crashed into a tree on the wayside and was knocked unconscious. The accident happened shortly before a crossroad point, and the motor column attempted to go ahead without the guide. The wrong road was chosen, and the column brought up a half hour later at the field kitchen station belonging to another army corps. Nearly ten miles away a regiment was out of ammunition and had to withstand a withering fire from the enemy without being able to reply effectively.

### The Rubber Tire Problem.

Except on the fast cars used by the officers, pneumatic tires are strictly tabooed. Even on motor ambulances the solid rub-

MOTOR CAR RESOURCES.*

| Type of Motor Car | Great Britain | France | Russia | Belgium | Servia | Germany | Austria-Hungary | Turkey |
|---|---|---|---|---|---|---|---|---|
| Armored Cars | 500 | 500 | 200 | 50 | ........ | 1,000 | 300 | 100 |
| Subsidized Trucks | ........ | 1,200 | 300 | ........ | ........ | 1,400 | 600 | ........ |
| Other Heavy Trucks | 18,000 | 15,000 | 500 | 200 | 50 | 15,000 | 3,000 | 300 |
| Gun Tractors | 150 | 300 | ........ | ........ | ........ | 500 | 200 | ........ |
| Touring Cars Available | 250,000 | 95,000 | 15,000 | 10,000 | 100 | 60,000 | 20,000 | 500 |
| Special Army Vehicles | ........ | 300 | 100 | 50 | ........ | 1,000 | 500 | ........ |

* These figures have been compiled from the latest available official statistics, combined with estimated new production by companies under military control; estimated waste of the first four months of the war, calculated on the basis of 30 per cent of the total in use in September; and the reported supplies of British cars to Russia and American cars and trucks to Great Britain, Russia and France. The figures make no claim of absolute correctness, but are merely as close estimates as an "outsider" is able to make at this time. They cannot be far out of the way.

ber tire is preferred, because of the immense trouble caused by bullets or shrapnel penetrating the pneumatic—usually at the most inopportune moment. On some of the British armored cars twin pneumatics are used on the rear wheels, but in the majority of cases solid tires have been mounted. Safety in this case is preferred to a certain degree of comfort.

In one of the dispatches sent by Gen. French to the British government, emphasis is laid on the necessity of having enough spare tires for all sizes of wheels. A whole fleet of trucks had to be abandoned and scrapped during the wild scramble across northern France because there were no extra tires for the trucks! Motor truck experts now at the front calculate the destruction of vehicles at about 60 per cent of the total, figuring that not more than 40 per cent of the motor trucks sent to the front will ever return in condition to be useful for anything else. The estimate of the British is slightly higher, reaching nearly 70 per cent, while that of the Germans is less than 50 per cent. Several hundred good British and more than a thousand French and Belgian trucks are reported to have been repaired by the Germans in the big F. N. and Minerva automobile factories in Belgium. The Minerva plant, especially, has proven of great value to the invading army, because of its location at Antwerp, so near the scenes of fighting.

### Special Equipment.

Among the special types of vehicles employed in the campaign are a number of 200 horse-power motor plows which dig trenches three feet deep faster than a hundred men can dig them with spades. Huge steam tractors with regular roller wheels for smoothing roads are used for pulling the heaviest weights, while caterpillar tractors, of the type made in Iowa and Illinois, pull the heaviest siege guns.

Searchlight wagons are used extensively, some with acetylene and some with electric lights; powerful trucks equipped with electric dynamos for charging wire entanglements with high-voltage electricity; aeroplane towing and repair wagons; swift, small mail delivery wagons, "cyklonettes" on the German side; light four-wheelers on the side of the Allies.

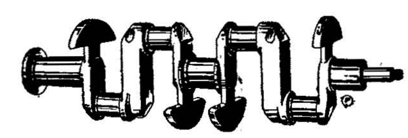
Military tactics to-day may be said to rely pre-eminently on the motor and its speed. Attacks reaching forward at the rate of thirty miles a day are no novelty in 1915. Retreats, in complete order, at a speed of fifty miles a day would have been called impossible by military men twenty years ago. The motorcar has revolutionized warfare. In its complete destruction of all the lore of centuries regarding military tactics it has proved as ruthless as the much talked of 42-centimeter siege gun of the Germans has to the fortresses of the past century.

## The Car of 1915

(*Concluded from page 10.*)

of counter-balancing his crankshafts. This lightening and balancing has come as a matter of course, for it is absolutely essential in view of the higher piston speed of the modern motor.

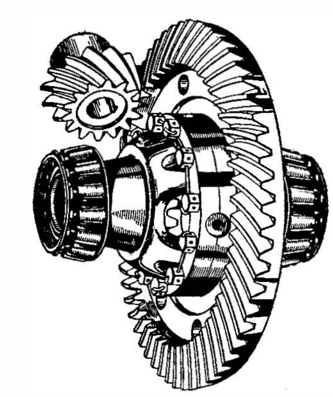
In gearsets, not a great deal of change is noticeable; it is significant of changes that may come, however, that one maker has adopted a type in which all gears not in use remain idle and not idly rotating, as is the more usual custom. This, of course, reduces both power waste and wear, and may, therefore, be looked upon as commendable. Disk and cone clutches hold about their accustomed places in popular esteem, but there has been a notable change in propeller shafts. In quite a number of cases, these now are tubular instead of solid. Hence, they are at once lighter, stiffer and less liable to the whipping which may constitute a grave evil



**Counterbalanced crankshaft.**

in some of the modern long wheelbase vehicles.

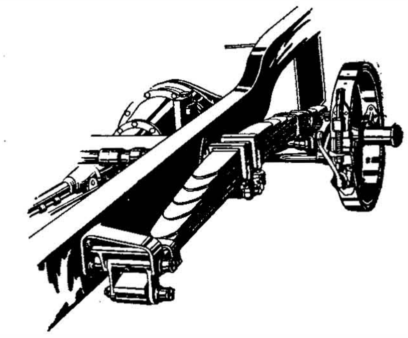
In methods of final drive, the worm scarcely has made any advance, though one maker has adopted it during the year. In the commercial vehicle and electric passenger vehicle fields, however, it steadily is coming into more extensive use. But in the gasoline pleasure vehicle field the combination worm and bevel gear, or, as it is styled, the spiral bevel gear, answers practically all of the requirements of the worm gear, but offers few if any



**Spiral bevel gear.**

of its disadvantages in the way of manufacturing difficulties and mounting problems.

Still another place where the promise of last year has been lived up to is in the spring suspension. The cantilever type of spring, which last year first became at all common when a number of makers adopted it all at once, has become still more common and now has taken a firmly intrenched place in the industry. Its de-



**The cantilever spring.**

monstrated efficiency, coupled with the worthy fact that it costs less than other systems using more material to obtain a similar result, has brought it to the attention of the industry.

These are some of the things that distinguish the car of 1915 from the car of 1914, though they are not all. They are a following out of the various tendencies which made themselves apparent a year ago at this time. They are nearly all *little* changes for the better, and their very smallness, when taken each by itself apart, compels the conclusion that we may no longer look for big, revolutionary changes in an industry so well founded on sound engineering principles.

## The High Speed Automobile Motor

(*Concluded from page 11.*)

discriminating selection of materials, and the very highest grade of engineering skill and workmanship throughout.

It is this very high standard of manufacturing required, combined with the old, long-recognized dislike of Americans for high speed motors, which makes automobile builders hesitate about adopting them as a regular feature. The Frenchman, with small output and skilled hand labor, can maintain this required standard without much difficulty, but to accomplish it on the scale of the American factory output is a far different thing and calls for much preliminary work and experiment before it can be safely launched upon the market.

As regards the four principal features which must be considered in the manufacture of the high speed motor, that of suitable valve mechanism is probably the most important as well as the most vexing problem confronting the engineer at the present stage of development. In fact, it is undoubtedly true that this type of motor really waits at present upon the satisfactory solution of the valve mechanism more than anything else from an engineering standpoint.

We are in the midst of the melting pot era on valve design, when every conceivable type of mechanism from modified poppet style to so-called sleeve, rotary and piston types is being experimented with, adopted, or advocated. There is much confusion of ideas among engineers as to the relative merits of each, because all types have not been tested enough yet under actual service conditions, and particularly under high speed requirements, to promote confidence as to their thorough practicability. Furthermore, the introduction of the sleeve, rotary and piston valve types complicates the matter by the direct relation they have had upon the lubrication problem. If such valve mechanisms are adopted a delicate adjustment of lubrication must be provided to prevent excess accumulation of oil on the ports at slow speeds and oil starvation at high speeds. The range of motor speed being greater, the difficulty of such lubrication is much increased over that encountered on relatively slower-speeded motors.

The ordinary poppet type of valve affords a much simpler problem as regards lubrication, but has two serious drawbacks for high speed use. One of these is its smaller relative port area, which tends to cause strangulation of the entering charge as well as of the exhaust gases, and hence reduces efficiency. The other is the risk of actual fracture of the valve stem and consequently serious motor damage due to the terrific hammering action of this style of valve. This type is also more difficult to keep in adjustment on high speed work. Few people realize how great this strain is in poppet valve action. At a speed of 2,000 revolutions per minute of the motor of four-cylinder design each valve must be jerked from its seat, raised, say, ½ inch, and dropped again through the same distance one thousand times in a minute. The actual time used for the complete opening and closing of the valve is of course only a fraction of a second, and it is this high frequency of successive hammer blows which finally causes rupture of the valve stem, even though the blows are small relatively in intensity. Also the alternate heating and cooling of the valves, particularly of the exhaust valve, has a deteriorating effect upon the strength of the latter and hence shortens its life. These two valve destroyers have their most powerful effect in the high speed motor on account of its extreme properties in all directions, and it is therefore easily apparent why the valve mechanism must be very carefully worked out and given a most searching test before adoption as a standard product.

It is of course only a matter of time before a thoroughly satisfactory valve mechanism will be developed for this style of motor and combined with an efficient oiling system, but until these two vital features are satisfactorily disposed of we are not likely to see any extensive manufacture of this type of engine, however desirable it may be.

The matter of balance has already been pretty thoroughly met and the rules to be followed are more or less generally understood by all automobile engineers. The introduction of forged steel piston rods of very uniform size and light weight as well as of composite aluminium pistons has considerably simplified this problem of late. In high speed work kinetic balance is of very great importance and the old methods of balancing according to static principles are no longer sufficient. For instance, a flywheel when mounted on a shaft and set on knife edges can be balanced statically without great difficulty by merely drilling into the side of the rim of the heavier portion, but this does not give any assurance that the center of gyration will coincide with the axis when it is revolving. To secure a sufficient approximation to the latter ideal condition necessitates a very careful testing of all the revolving and reciprocating parts. Failure to maintain this high standard of balancing practically eliminates the motor from any bid for success in the high speed field, for its balance must be so perfect that its real motor speed cannot be readily detected. The slightest unbalance produces vibration, which in turn attracts the attention of the occupants of the car to the speed of revolution of its motor. To be a real success, the latter must be literally unobtrusive as regards noise and vibration.

Much of the success of the balancing problem depends upon the skill of the designer in proportioning the relative parts and selecting the materials, so that no useless metal is present in the rotating or reciprocating members. The proper combination of strength with lightness in such units as the pistons and connecting rods, crankshafts, etc., is of the utmost importance, and of course the lighter these parts can be made the easier the balancing problem becomes. From the very nature of the design the parts of a high speed motor of equal power to one of much slower relative speed ranges can be made considerably lighter, for the necessary increase in power is obtained by the greater speed of the motor, and the piston and hearing pressures are therefore less.

The common practice of balancing by merely paring off component parts, such as opposed pistons, will not suffice for high speed standards. Such an arrangement is liable to produce a disagreeable fore and aft traveling or periodic vibration along the crankshaft and is a makeshift arrangement at best. Each piece must be weighed, inspected and sorted, with the object of maintaining the duplicate parts of each individual motor at the highest possible standard of uniformity.

The importance of the balancing proposition will call for a considerably higher standard of interchangeability of parts than heretofore, and in fact the repair men will also come in for an increased share of responsibility when it comes to overhauling such motors. It will never do, for instance, to put in an extra large piston in order to stop oil from passing by into the combustion chamber or resort to any other of the numerous tricks familiar to the gentry when attempting to rejuvenate wornout motors. A little careless work of this character would ruin the finest built high speed motor from the balancing standpoint.

When the small, quiet running motor of this type is finally produced, however, on a really successful commercial scale, it bears promise of causing a considerable revolution in motorcar design, the principal effects of which will be in the saving of space and weight and in the matter of economy.

These savings begin with the motor itself, which can be made lighter and very much more compact for a given horsepower output than anything we have been accustomed to. On account of the higher speeds at which it runs, all shafting and gears can be made lighter, and by reason of the shorter wheel base possible from this compact design a still further reduction in weight is secured. This weight reduction proceeds all along the line with

a total amount that will prove a strong inducement to the would-be purchaser who has become tired of the constantly increasing weight of touring cars in recent years. This feature we believe will have a particularly strong appeal when it is further realized that the same power is still available in an even smoother drive than formerly with the slow speed type, and fully as much, if not more, room and comfort. At ordinary car speeds a four-cylinder motor of the high speed type should very closely approximate the smooth torque of the six-cylinder motor and afford a drive entirely free from the objectionable jerking and bucking of the large high-geared four-cylinder type when the latter is throttled down finely. Constant tinkering and tuning up would not be as necessary on this type either, as an occasional skip would scarcely be noticed except when the motor was well loaded down.

Another important feature not often mentioned in analyzing the principal characteristics of the high speed motor is its valuable braking property. Anyone who has ridden in the front seat of a taxicab with the driver must have observed how readily these little cars slow down by merely closing the throttle and leaving the clutch in. The great value of this feature is better appreciated when one considers the simplicity of control afforded by using the throttle for retardation as well as for acceleration. A taxicab driver would be well-nigh exhausted at the end of a day's running if he had to release his clutch and apply either the foot or hand brake every time he slowed down. In the touring car with high speed motor and comparatively low direct drive gearing this motor braking property would be even more pronounced than in the ordinary type of taxicab and would greatly simplify car control particularly for new drivers.

When looked at from all angles it would appear that there already exists a strong under-current of opinion among motorists favorable to the commercial exploitation of the high speed motor type of car; not for the sake of the high speed motor itself, but because of the relief which it seems to promise from the constantly growing burden of weight and increased running expenses. Its successful development, however, must wait the solution of its manufacturing difficulties, and there is evidence that American manufacturers are now working to gradually evolve a motor which will meet these high speed requirements.

## How Small Communities May Have Good Roads

(*Concluded from page 15.*)

who have charge of all the public roads, that if the Commercial Club would pay all costs over and above that of drainage and grading, they might proceed as they wished on any piece of road, not to exceed one mile in length. It was decided to select one of the worst sections and improve it as an object lesson of what could be done with available funds and materials. A road expert was secured from the Office of Public Roads to make the detailed plans and supervise the work. As typical of the worst road problem confronting that region, a road was selected which for several months of the year was practically impassable, because of lack of subdrainage. This road was properly drained and surfaced with gravel. So striking and convincing was the object lesson that before the expert had entirely completed the work, the county supervisors were calling for contracts involving the drainage of several thousand feet of road in the vicinity.

**A State Department Promotes Co-operation.**

In the Blue Ridge Mountains of Virginia, a road 14 miles in length passes through three counties. Eight miles are located in Albemarle, four miles in Augusta, and two miles in Nelson County. This road had long been in need of improvement, but because of the three distinct jurisdictions, no concerted action was reached until the State Highway Department pointed the way. Here was a road in which three counties were vitally interested, the cost of improvement of which would not be less than $7,000 per mile, and furthermore, piecemeal improvement would be of but questionable value. The entire road must be improved as a single unit. The State-aid allotment available that year for each county was set aside for this road with the understanding that the local communities raise the additional funds required. In Albemarle County a portion of the funds was raised by private subscriptions by the citizens and the county appropriated the remainder. In Augusta County the county authorities appropriated the necessary funds, while in Nelson County the entire local fund was raised by popular subscription. The State prepared the necessary plans and supervised the construction. This road was thus built through the co-operation of the State, the counties, and private citizens.

**Administrative Organization Essential.**

Whether co-operation in road work among smaller communities will be efficient and prove of real and lasting value or but a costly experiment, depends largely on the administrative organization. Haphazard co-operation cannot be too severely condemned. It invites extravagance and is inefficient in the expenditure of labor and funds. It works without system and lacks the proper co-ordination with the larger interests of the county and State. But, on the other hand, properly organized and directed co-operation furnishes a means through which local communities may secure better systems of road management, more efficient returns from their road expenditures, and better roads. This kind of co-operation will give them roads which are adapted not only to their own local needs, but also adapted to meet all the requirements, both present and future, of the county, State, and nation.

## War Experiences of an Air Scout

(*Concluded from page 20.*)

siderably faster in speed, and capable of climbing 7,000 feet in fifteen minutes, thus making it a very desirable machine for scouting purposes as well as to give fight to any of the German machines, since some of these machines were equipped with machine guns operated by the passenger, while others were fitted with bomb-dropping devices. It is excellent also for observation work and the dropping of small round, pointed, and grooved iron pencils in quantities of a thousand at a time. The latter proved very efficient when dropped over the enemy on the march or into their trenches.

**Off to the Battle Front.**

On October 17th I received the long-looked-for order to go to the front in an *escadrille* of six Morane-Saulner monoplanes. That night five other pilots and myself left Tours for Saint Cyr, a few miles outside of Paris, where we found the six Morane-Saulner machines awaiting our arrival the next morning. The six of us visited the captain in charge at Saint Cyr, who ordered us to fly that day to the aviation headquarters near Arras, 150 kilometers from Paris. Maps were furnished us, which we prepared and placed in the map cases which are a part of every machine, as well as a compass, with which every apparatus in France is steered. A flight of ten minutes demonstrated to me that my apparatus was in perfect condition. At one P. M. on the 18th of October the six of us started at a few seconds intervals on our journey. Upon attaining a height of 2,000 meters, the six of us sailed from Saint Cyr toward the point where civilized men were murdering each other, and the fact that it would be but a matter of a few hours ere we would be accomplishing the same purpose with our deadly bombs seemed hardly believable.

The journey, a short one, seemed awfully long to me. Several times, with the aid of field glasses, I could see far below me thousands of soldiers marching toward the battle front. Destroyed bridges over the Oise and Somme rivers showed me ground that had been occupied

by the Germans a few weeks before. After flying for one hour and a half the portable hangars of the temporary aviation headquarters just to the south of Arras appeared visible. A few minutes later I was directly above them. Shutting off the motor I volplaned down in a spiral glide, and a few seconds later was again on *terra firma*. The six of us had made the flight of 150 kilometers without mishap. I was anxious to get into the fray at the earliest possible moment, so I immediately reported to the commanding officer, who appointed a junior officer to accompany me as observer on my flights; the first to be made the following morning at six o'clock.

**Patrolling the Sky.**

The next morning at six o'clock my observer, who was able to speak good English, and I were up and anxious to fulfill the work that lay before us. A heavy fog was a great disappointment to me and caused a delay in our start. It was at least ten o'clock before the captain would permit us to start away on our flight. Our course had been prearranged, and it was the duty of my observer to make notes of the movements of the enemy's troops. Several other apparatus started away at the same time we did. Rising to a height of 2,250 meters (7,000 feet) I headed the machine toward Douai and thence toward Lens. The flight lasted a little longer than one hour, and proved to be intensely exciting. At times it was impossible to see the earth directly along the line of battle, owing to the terrific cannonading that was going on; the smoke was so dense that it seemed as though we were flying above the clouds. We penetrated the enemy's line for a distance of half a dozen miles, where the actual movement of troops was going on, the data on which was quite important to the French. There appeared vast columns of soldiers that, in the winding roads, seemed like great big snakes crawling slowly along. From our extreme height it was hardly possible to make out the direction the troops were traveling; but after circling over the point for ten minutes, my observer detected with the aid of glasses the direction in which they were heading.

**The Death Dealing Arrows.**

In one hour of flying the observer who accompanied me had sufficient time to note nearly every action of troops belonging to the enemy that we had flown over; and upon alighting his notes were immediately dispatched to the front. Three bomb-dropping machines and one equipped with several thousand of the sharp-pointed, steel arrows, or pencils, as they are sometimes called, were dispatched to raise havoc with the enemy's troops that were on the march. For this purpose the steel arrows, which are about 4½ inches long, round, and sharp on one end, and grooved out on the other end, prove a very good weapon. They are dropped from the aeroplane while in motion in quantities of 1,000 at a time. They spread out over an area of 300 square feet, and after a fall of say 6,000 feet, they will penetrate almost anything. The French were the first to invent them, and the Germans, seeing their good work through the damage done to their own men, copied them with the following words cast thereon: "Invented in France, but made in Germany."

**An Aeroplane Lost.**

Of the four machines that started out on their murderous journey to the enemy's lines, one did not return. He suffered the same fate that he and his passenger were dealing out to the Germans below. From one of the other three aviators who had accompanied the unfortunate, I learned that he was a young officer, and being very desirous of making a good showing, had, upon reaching the enemy's line, descended to quite a low level, where he attempted to dispatch with better accuracy the bombs he was carrying. Terrific rifle and machine-gun fire was immediately directed upon his apparatus, which suddenly began to wabble and then plunged head first down to a horrible death. Both the pilot and passenger must have been instantly killed, and the horror of having seen his fellow pilot killed

drove my informant nearly insane. I learned that the loss of life among the aviators at this particular line of battle front had been quite severe, and averaged about two a week since the war began.

Not having been ordered to do any flying that afternoon, I visited one of the battlefields in the vicinity, where fighting had taken place weeks before. I should have liked to visit the present point of fighting, but permission was refused me, as all aviators must remain, both day and night, at their headquarters, and see that their apparatus is always in a flying condition, in order to be ready to move at a moment's notice, should the commander receive orders from the front to advance or retreat.

(*To be continued.*)

## American Automobile Coachwork

(*Concluded from page 21.*)

is given in Fig. 5. When it is desired to open the car the top folds back with little overhang. The windows drop into pockets and are not taken out and put behind the driver's seat with a moral certainty of breakage sooner or later. This particular body has only two doors, but the four-door type is even more popular. The V-front is a feature which might well be copied here on bodies of types other than the cabriolet.

Fig. 6 represents a type of town carriage, also of English make, but French design, in which the comfort of the driver is not considered. The addition of a windshield and top would completely alter the character of the body. The toolbox in the middle of the running board, although countersunk, does not enhance the beauty of the car.

In Fig. 7 is seen a touring body by an American coachbuilder. The top disappears completely into the body, there being no visible casing. Unfortunately with this type of top a dust screen is often necessary, thus spoiling the very effect obtained after much expenditure of ingenuity.

The subject of Fig. 8, although of the same general type as the preceding example, is much less successful. If the sidelights were set in the cowl, the front door widened to the size of the rear one and the outlines of both changed, and if the top cover were neater, the body would be quite handsome despite the great handicap of the 26-inch height of the frame from the ground.

In this connection I believe not enough attention is paid to the proportioning of the various spaces on the sides of a touring body. If the following points were observed one would see fewer unsuccessful designs.

1. Two adjoining spaces should not be equal.

2. Front and rear doors should have the same width, if possible. The rear door should not be cut out at the back.

3. The space between the doors should be perceptibly greater or less than the width of the doors.

4. The height of the doors should be perceptibly greater (or less, in a two-door body) than the width.

5. The height of the body sides should be perceptibly greater than either the height of the frame above the ground or the distance between the top rail of the body and the lower edge of the top when extended.

One would almost believe that the limousine landaulet shown in Fig. 9 is a foreign product were it not for the coachmaker's nameplate. The rear light is admirably large. Except for such details as the rather obtrusive hinges there is very little to criticise. The same may be said of the clean cut berline in Fig. 10 by the same coachmaker. In this case, however, the hood is not sufficiently tapered, with the result that there is a rather sudden swelling at the dash.

The bodies we have been examining were made by firms conversant with contemporary foreign design. The bodies of American cars, however, are made, as a rule, by the manufacturers of the chassis or else turned out by the hundred by

wholesale body builders. The result is that American cars have very little individuality, all that is allowed the purchaser being a choice of certain colors.

If we accept this excessive standardization as a necessary evil we should at least insist that the bodies forced on the purchasers should not be lacking in beauty, comfort and convenience. Yet too often is not this the case?

Take for example the windows in closed cars. It will almost invariably be found that they open little more than half way. If this occurred only in the rear light it could be understood as the mudguards interfere unless the body is kept within the frame. It is really unpardonable, however, that the door lights should not open completely.

Handwheels instead of the old sash and peg are now much used for operating the windows. The French practice of fusing a small handle upon the glass, and of fitting springs at the bottom of the window well powerful enough to compensate for the weight of the glass, may also be cited. The slightest pressure is sufficient to move the glass up and down. Care must be taken not to place the handle near the top of the window as otherwise the glass may crack.

With the individual front seats separated by an aisle now coming into vogue it would be so simple to make them adjustable. Apparently all drivers of any one make of car are expected to be of precisely the same height. How often we have seen tall drivers with their knees jammed against the steering wheels of their cars. If the front seats had a fore and aft motion of only a few inches a tremendous increase in comfort would be made. The ideal arrangement would be, of course, to have all seats adjustable longitudinally, vertically, and as to inclination.

In Fig. 11 a rather novel sedan is shown. It has two entrances, the one on the right including the center window, which is narrower than the corresponding one of the left. This body has its good points, but mounted on a frame almost 28 inches high it is placed at a disadvantage. As this is a single compartment body why are the beautiful striped curtains confined to the rear windows? Why not be logical and drape them around all the windows?

The body in Fig. 12, a limousine with cab sides, has quite pleasing proportions, but is slung far too high above the ground. I well remember that at the last Paris salon the exhibitor of this make had cleverly arranged ramps approaching the car from the sides, so that would-be purchasers accustomed to low-hung European productions would not be overwhelmed. It seems a pity that with the steering wheel at the left the driver cannot get out on his own side. The rear fenders have had the same outline for eight years, so that it is perhaps too late to suggest changing them, but they would really be more efficient if carried lower down behind the wheels. The bonnet, although slightly tapered, does not make the slightest pretense of merging into the dash, which is of the full blown convex type.

Windshield stay rods are still retained on the touring cars of this make (see Fig. 13), but are mere shadows of their former selves. The spare tires prevent the top from folding down neatly. The upholstery of the front seat arm, part of which is fastened upon the top rail of the door, should be noticed.

The general proportions of the touring body represented in Fig. 14 are very good. It is here seen that in order to provide sufficient clearance for American roads the frame need not be swung ridiculously high. The mudguards are very successful. Almost the only room for improvement lies in the upholstery. As probably no one sits on the doortops why upholster them?

In Fig. 15 is shown a boat body with an aisle between the front seats, which would be very pleasing were it not for the windshield irons, which are brought down far too low. The removal of the radiator cap from its usual place strikes the eye at once.

The body in Fig. 16 represents a considerable advance over those on the 1914 models, but it is far from perfect. It suffers chiefly from a plethora of moldings, especially on the hood and mudguards. The angle between vertical and rounded portions of the bonnet is continued in the cowl, giving the latter rather an awkward form.

Fig. 17 shows an attempt to build a difficult body—a domed roofed landaulet. It is unfortunately a failure from the point of view of appearance. The sides of the body are too low in relation to the window height. The rear light, however, can be lowered almost out of sight, a very good point.

The sedan in Fig. 18 is one of the best looking cars of its type. The roof should have been slightly more domed, rounding off into the back and having a drip molding along the top of the windows, or if the flat type it should project slightly in front. Arranging the door to open the other way would enable more of the running board to be of use.

We now come to what is perhaps the most advanced American stock touring body (Fig. 19). Its general lines are good, the second cowl being very well worked out. It is unfortunate, however, that on a four-cylinder chassis of 132-inch wheelbase it was found necessary to cut a piece out of the rear door. Also why should the driver be compelled to climb over the front seat passenger to reach the ground? If the spare tires were moved a little more forward and the front door farther to the rear it could be turned from an imitation door into a real one. Here I shall let the reader into a secret. There is a brake lever blocking the driver's exit in any case! Good points about the body are the high sides, the tumble-in along the top rail and the lack of protruding upholstery. A neat touch not appreciated in the photograph is the inclining of the windshield rearward two inches.

Compare the above body with that shown in Fig. 20, and the improvement resulting from concealing the upholstery is evident. The front seat in the latter car seems in imminent danger of bursting. One would little imagine that this body and that shown in Fig. 7 are both mounted on similar chassis. Such, however, is the case. Compare the relative positions of the steering wheels in Figs. 19 and 20. In one case the driver sits in the body, in the other case he sits on it.

The subject of Fig. 21 is one of the most powerful cars on the market, and it looks its part. The frame has been dropped abaft the hood, giving it a low-hung appearance despite the very large wheels. There are few points for criticism. The sides of the body might with advantage be as high as the hood, thus reducing the gap between body and top and hiding the folding seats. The ventilators at the base of the windshield, while efficient, are not beautiful. As the hood is not tapered there is a sudden swelling at the dash as in Fig. 10. An aisle separates the front seats, a very popular feature for 1915. On a two-door body it is better than a sliding or folding front seat, but as it reduces luggage carrying space it is not always desirable where unnecessary, as in this case.

The mudguards are very fine pieces of work. Particular notice should be given to the front ones with the lamp shells and valances in one piece with the guards themselves. The practice of this firm in mounting the headlamps on the mudguards has not been followed; 1, because of the difficulty in making the fenders perfectly rigid; 2, on account of the difficulty of refocusing the lamps to suit the individual driver; 3, on the score of appearance. In this position, however, the lamps can light up the holes in the road and not merely cast dense shadows across them.

In concluding this article perhaps I may be permitted to refer to a sedan body which I designed exactly two years ago. As seen in Fig. 22 the wind resistance is reduced to a minimum not only by the small surface normal to the direction of travel, but also by the hemispherical shape of the stern, which reduces the vacuum

behind the car and so minimizes the dust. A segment of the back swings open, giving access to a circular compartment for the spare wheel. This arrangement is, I think, ideal as the wheel is completely protected from the elements and does not mar the clean appearance of the car now considered so desirable.

### Motorcycling Under Fire

THE present great war in Europe has been called, with a good deal of truth, the Motor War. For the first time in the history of the world, gasoline has become a factor of the utmost importance in the weal or woe of nations. Never since the invention of gunpowder has war suffered such an upheaval, has the science of war been subjected to such tremendous changes, as in the year of grace 1914. Textbooks on military tactics more than ten years old are as obsolete to-day as if they had been written previous to the discovery of steam and the transportation of armies on trains and steamships.

In the great glamour which naturally has been thrown around the automobile as the last word in rapid transportation of armies, one is apt to forget the "Little Brother of the Motorcar," as the motorcycle has been so well named. Not even the aeroplane has done as much service in the present war as the omnipresent, pestiferous, and yet self-effacing two-wheeler, whether propelled by the sturdy legs of the soldiers or the crackling, rattling explosions of the gasoline motor. There are probably more than 50,000 bicycles in active service at the "front" or immediately in back of it, and yet the newspaper-reading public hardly knows there is a single wheel in use. The splendid work of the automobile has overshadowed the less showy but just as important work of the bicycle, while the great usefulness of the motorcycle is but now beginning to be appreciated.

Limited by the manner of its construction and the demands for high speed, the motorcycle, of course, has not been heralded as an attacking or raiding medium as the automobile, or as a carrier of provisions and ammunition like the motor truck and omnibus, or as a savior of the wounded during the battle, as some small tricars and runabouts, but in its special field as dispatch bearer and guide, as well as an occasional reconnoitering patrol, it has surpassed the expectations of its users and supporters.

Letters from the battlefields rarely mention the motorcycle, but occasionally one gets a glimpse of its work in reports sent by the riders themselves to their favorite trade paper or perhaps to one or the other of the great British dailies. In a report covering the action in the Compiègne forest in the early stages of the war in France a British motocyclist tells of the troubles he had. "A most useful duty has been found," he writes, "for a number of our motorcyclists in watching and following any man suspected of being one of the numerous spies which the Germans maintain behind our lines. These generally work in British and French uniforms and they almost invariably get about on motorcycles, as not only can they thus cover more ground, but they are much less likely to run against inconvenient questioners. One, dressed as a British officer, was brought into the station at Compiègne while I was there. He had been collared by one of our own wheelmen in a rather curious way.

"For two or three days this motorcycling spy had been persistently shadowed by the Britisher, who at last, finding his quarry compelled to dismount, accosted him with a query as to his duties. The man, who spoke perfect English, laughed pleasantly and said he was on staff work. Our cyclist asked if he had any papers to show, adding that he himself was on police work. The stranger was quite willing to oblige and produced from his pocket some papers. 'That will show you who I am,' he remarked casually, displaying a couple of private letters directed to a Captain ——— of the ——— Regiment.

"'That's done you,' retorted the Britisher, covering the man with his revolver.

'It just happens that the man whose letter you've got is a particular friend of mine.'"*

Another British rider who was with the expeditionary forces of Great Britain says the life is none too easy. "The motorcyclist has to shift for himself; he moves too fast, too sudden, and too often to have any regular headquarters, so far as his eating and sleeping are concerned. After he has delivered a dispatch and is dismissed for the time being, he sets out to find somewhere to wash, something to eat, some place to sleep, and last, but not least, gasoline." He has no speed limits to worry over, but the disastrous consequences of running at high speed into the rear of a dark motor truck serve to keep his eyes straining and his ears alert, feet on the brake pedals, ready for instant action.

One of the greatest troubles of the motorcycle rider in war-ridden France and Belgium is the necessity of riding without a lamp at night. The explosions of the motor are loud enough to cover the call "Halt" of a sentry, and it is related that several motorcyclists were shot to death and a great many fired at by their own sentries because of their inability to hear the "Halt" signal. On one occasion a rider just managed to stop his machine in time to get the point of a French bayonet to within a couple of inches of his chest. Less powerful brakes and he would have been dead.

Plans are under way at present, based on the experiences of the first four months of the war, to substitute a system of light signals at night for sentries. Flashlight lamps have been tried out, as well as the old style red light, from which a covering cloth is drawn at the proper moment.

Dispatch riders tell with gusto of their growing ability in dodging flying shells coming toward them. The large shells, in particular, can be clearly "seen" at night and quite a few of the riders succeeded in evading death by swerving around the descending shells. On one occasion a big shell struck about fifty yards ahead of two motorcyclists coming at top speed and the hole torn into the roadway was so big that the machines could not avoid it. Both went headlong into the crater and were severely injured.

Still more interesting and dangerous is the lot of the motorcycle dispatch riders who are taking part in the East African fighting. One of them, in a letter to his folk in England, tells the following interesting story: "The other night, when it was just getting dark, the captain had to send me to the next camp, twenty-three miles away, and there is only one track, running right through jungle all the way. Off I went on the most exciting ride I have ever undertaken. I was fully armed with a service rifle and revolver, hunting knife, water bottle, haversack, and ammunition. The first thing I ran into was a pack of baboons, some of them nearly five feet high. They were terribly excited and ran in front of the machine in the full light for about a mile. The brutes simply wouldn't shift. You ought to have heard them bark. I would not have gotten into their clutches for all the money in the world. However, they at last turned into the bush.

"I also saw two fine leopards. One brute did not attempt to move until I was within three yards of him. I suppose he finally thought it wiser to get out of the path of the glaring light and the roar of the engine. He jumped snarling to one side and—maybe I didn't go when I got passed him! He might have taken it into his head to follow me!"

While leopards and baboons do not bother the motorcyclist in the European field of war, he has his hands full with problems which somehow or other never seem to have been thought out before. For instance, it has been found that where a cavalry patrol of small size is chased by motorcyclists, all the former need do is drag a telegraph pole or tree across the road—there are hundreds of fallen trees everywhere along the roads! The horses can jump over, if trees are on the road: the motorcycles are detained long enough to allow the horsemen to escape. In one case three motorcyclists of the British force were surprised by a number of Uhlans and driven into flight. A tree lying across the road stopped the machines just behind a curve, and they were forced to dismount and fight from behind the tree. Several Uhlans were killed and wounded and two of the cyclists also were shot, when the third one thought of a loud police whistle he carried. His shrill blast took the Uhlans by surprise, they evidently believing it a call for assistance from some nearby force. They wheeled their horses and disappeared.

Motorcycles have been used in the field operations for the following work:

1. Carrying orders to the motor truck columns and to cavalry commanders.
2. Guiding motor trucks to their destination.
3. Calling ambulances and reinforcements, guiding them to the places where they are needed.
4. Assisting in dragging machine guns and gun sections.
5. Police work on the roads behind the battle line.
6. Reconnoitering, which was formerly accomplished exclusively by cavalry.
7. Acting as scouts in advance of long convoys of automobiles, seeing that the roads are safe for traffic and free of obstacles.

* Extract from a letter which appeared in the British trade paper, *The Autocycle*, in the last week of October.

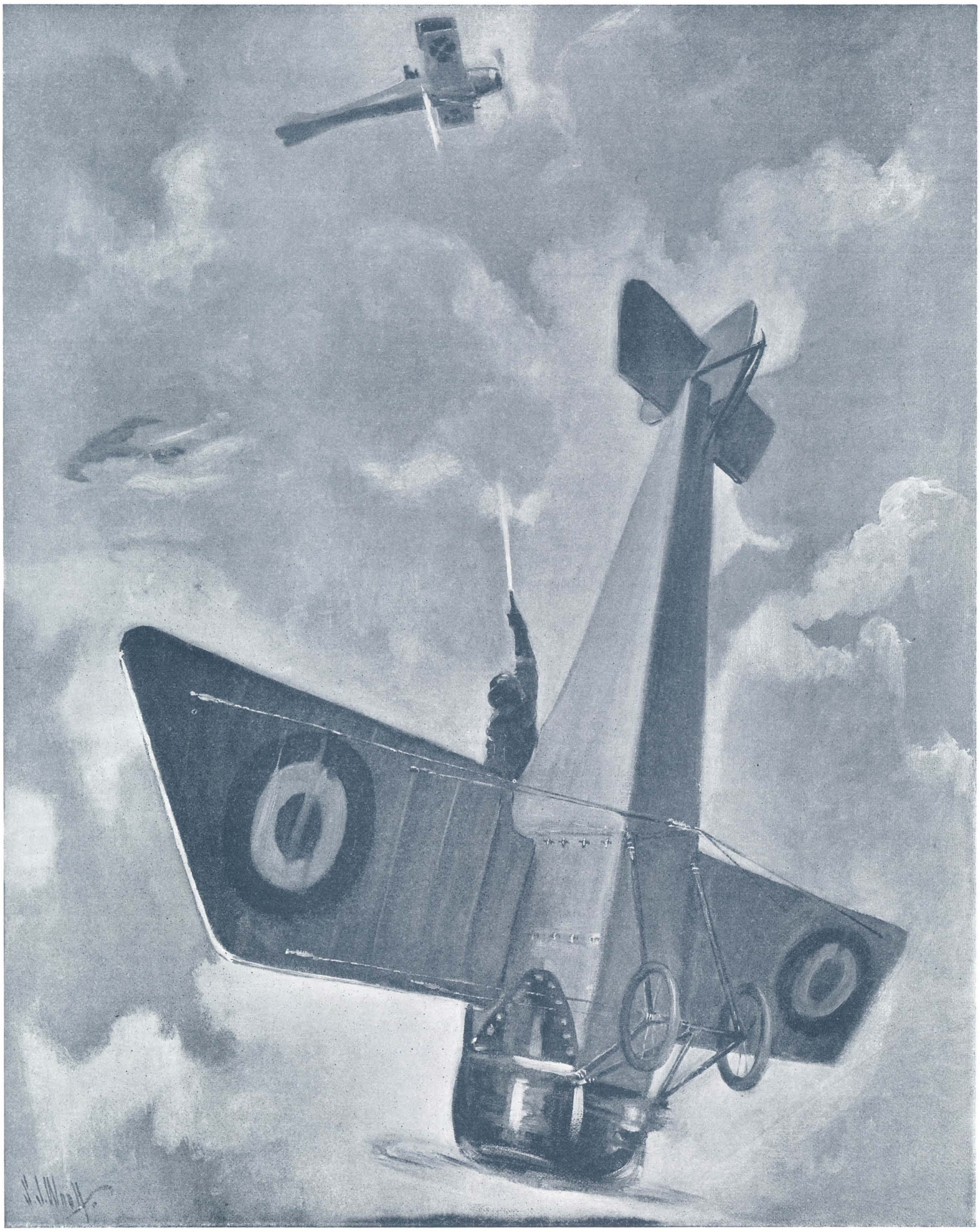
### The Good Roads Movement

THAT remarkable progress has been made in the building of good roads throughout the United States during the past few years is proven by data recently obtained by the American Highway Association and soon to be published in the official Good Roads Year Book for 1915. It has been found that more than 34,000 miles of surfaced roads have been constructed during 1913 and 1914, and that during the ten-year period from 1904 to 1914 more than 96,000 miles have been completed. That this progress has been really amazing may be understood from the fact that in 1904 there were only 153,000 miles of surfaced roads of all types in the United States. That the movement is attaining momentum as it goes is proven by the fact that while the average mileage constructed per annum during the past ten years is 9,600 miles, the total completed for 1914 exceeded 18,000 miles. The report will show that something like 30,000 miles of highway have been completed with the aid of State funds, of which over $200,000,000 have been expended. The State aid movement began in 1892 and has therefore continued for twenty-two years. Only recently has it gotten well under way, as the results accomplished for 1913 and 1914 comprise a total of 10,000 miles of State aid highways completed, or in two years' time one third of the entire mileage constructed with the aid of State funds has been completed.

Only six States now, out of a total of forty-eight, are without State highway departments, and thirty States have granted actual money aid to the building of roads. The Year Book, which is the official reference publication for all good roads information, is a large cloth bound volume issued early in each calendar year by the American Highway Association.

**Aggregation and Anticipation.**—In the recent case of Read Machinery Company v. Jaburg et al., Circuit Judge Hunt, in the decision, takes occasion to say with regard to aggregation and anticipation, as follows: "Aggregation, as I understand it, will not apply where there is a combination of elements capable of co-acting to produce a unitary result, provided such co-action produces novel and improved results which are useful," and that "Upon the contention that there has been anticipation it is necessary, as I understand it, that the defendant shall show that all of the elements of the plaintiff's patent or the mechanical equivalents are found in the same description or machine where they do substantially the same work by substantially the same means."

# SCIENTIFIC AMERICAN



A MAD PLUNGE FOR LIFE.—[See page 51.]

Vol. CXII. No. 2
January 9, 1915

Munn & Co., Inc., Publishers
New York, N. Y.

Price 10 Cents
$3.00 A Year

# SCIENTIFIC AMERICAN

**Founded 1845**

**NEW YORK, SATURDAY, JANUARY 9, 1915**

Published by Munn & Co., Incorporated. Charles Allen Munn, President; Frederick Converse Beach, Secretary
Orson D. Munn, Treasurer
all at 361 Broadway, New York

Entered at the Post Office of New York, N. Y., as Second Class Matter
Entered as Second Class Matter at the Post Office Department, Canada.
Trade Mark Registered in the United States Patent Office



**Subscription Rates**

| | |
|---|---|
| Subscription one year | $3.00 |
| Postage prepaid in United States and possessions. Mexico, Cuba, and Panama | |
| Subscriptions for Foreign Countries, one year, postage prepaid, | 4.50 |
| Subscriptions for Canada, one year, postage prepaid | 3.75 |

**The Scientific American Publications**

| | |
|---|---|
| Scientific American (established 1845) per year. | $3.00 |
| Scientific American Supplement established 1876. " " | 5.00 |
| American Homes and Gardens " " | 3.00 |

The combined subscription rates and rates to foreign countries including Canada, will be furnished upon application
Remit by postal or express money order, bank draft or check

**Munn & Co., Inc., 361 Broadway, New York**

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.


*The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.*

## Railway Safety and Railway Economics

WHEN the Interstate Commerce Commission in its annual report for 1914 recommended the compulsory use of steel cars in passenger train service and the prohibition of the use of wooden cars between or in front of steel cars in passenger trains there was brought to public consideration an interesting example of a matter apparently simple, but which carried with it many serious economic problems. As regards the second of these recommendations there can be no reasonable argument or insuperable objection. It is of course desirable that steel and steel-frame cars should be used exclusively on American railways at as early a date as possible, notwithstanding that there is a small minority of railway men who with sincerity argue that the benefits of steel cars are at least questionable. It is as desirable and essential for the rolling stock of American railways to be strong and fireproof as it is for everyone to live in a fireproof house, and to require fireproof schools, theaters, and other places of amusement and assembly. Furthermore, it would be desirable for everyone to eat the most nutritious food, to indulge only in hygienic occupations, and to live under absolutely sanitary conditions; but it is evident that such a condition cannot be brought about at once by the mere enactment of legislation or the promulgation of decrees. If increased safety requires considerable outlay, means must be provided for improved equipment, and the provision of such means is an economic problem, which must be considered no less than the physical strength and characteristics of the rolling stock. If there should be withdrawn to-day from American railways all wooden passenger cars there would result an unthinkable condition of congestion and inadequacy of facilities that would simply paralyze the railway transportation of the country. The replacement by all-steel construction must depend, of course, on the time in which the present manufacturers can supply such construction and new enterprises be formed to embark in such work under reasonably favorable conditions. As new rolling stock is demanded, all-steel cars can be and are now being generally provided, and means to carry out any proposed legislation which would involve the accelerated replacement of such wooden rolling stock must be obtained either by the sale of bonds or short-term notes, with corresponding effect on the fixed charges of the system, or by increasing the capital stock. Now, it is obvious that no greater number of passengers can be carried in steel than in wooden cars, and there can be no increase in receipts from such traffic; yet at a time when every possible retrenchment is forced upon the roads they are called upon to pull heavier trains, due to the extra weight of the steel cars, and to borrow money or increase their capital to provide such cars. They are of no corresponding economic advantage, except that the steel car has a longer life and requires less attention than the wooden car, with a resulting saving each year in the amount of depreciation to be written off, and, in the event of accident, there is less liability to serious injury to passengers for which settlement must be made, either as the result of litigation or otherwise. The railway is now called upon to maintain a higher standard of service, for which its patrons at present are not called upon to pay more, notwithstanding their increased safety over what they have considered for more than half a century a reasonable and ordinary hazard of their daily lives.

Granting that increased safety is desirable, let us consider what are the economic problems. On December 31st, 1913, on 227 railways, operating 236,720 miles in the United States, there were in service a total of 58,660 passenger cars, of which 44,650 were wooden, 9,492 were of steel, and 4,608 were supplied with steel underframes. That this is a rapid increase in steel and steel underframe cars is shown from the fact that on January 1st, 1909, there were in service but 629 steel cars and 673 with steel underframes. In the year 1913 there were acquired 2,111 steel cars and 1,019 with steel underframes as compared with 2,366 wooden cars retired from service, and this rate of increase may be considered fairly typical of the normal progress now being made without compulsory legislation, there being but few wooden passenger cars, 220 in 1913 being added, and but 15 under contract at the end of the year. Now, the average cost of the steel passenger car has been put at about $14,000, ranging from $8,500 for a baggage or express car to $22,000 for a parlor, sleeping or dining car, and consequently to replace the 44,650 passenger cars of all forms in the United States on January 1st, 1914, where previously 1,000 new wooden cars a year was about a nominal increase, there would be involved an expense of practically $600,000,000 to replace all wooden passenger cars. Deducting the normal annual increase under a scheme of compulsory replacement, within ten years the railways would be called upon to spend $392,000,000 to replace cars neither worn out nor otherwise unserviceable. Now, to raise the sum of $392,000,000 in these times of financial stress and war conditions would be a stupendous task. Perhaps it will be argued that this expenditure could be spread over a number of years, so that the desired level of safety would be reached gradually. Granting this, it must be admitted that any legislation which demands not only an increase of over 50 per cent in the cost of each unit of rolling stock, but the addition of an inordinately large number of such units, must be considered with most conservative forethought.

## The Invisible Man Behind the Gun

PERHAPS one of the most unoriginal remarks one can make about this war is to say that it is a war of mechanism. The remark is perfectly true, of course. We constantly hear of positions being taken by the French because of the superior qualities of their "seventy-fives"; and the Germans, when faced by an exceptionally stubborn resistance, always seem to bring up their heavy howitzers. The opposing forces seem to be about equally brave; that is to say, they are all about as brave as men can be. The difference between advance and retreat is usually due to machinery, But, although mechanism is emphatically the great characteristic of this war, it seems to have played a very prominent part in nearly every war.

About the time of Edward III of England, English archers were better than other archers—they could shoot farther. This might be attributed to the superior muscular power of Britishers compared with foreigners, which was an article of faith with Englishmen. The truth is, the English had longer and stronger bows, i. e., their mechanism was superior. It is not, perhaps, altogether a coincidence that in those days the English usually won their battles. The more obviously machine-like cross-bow and the early forms of cannon largely counterbalanced this English superiority in the long bow. The superiority of mechanism worked by gunpowder became so obvious that it led to the complete abolition of all forms of bow. It would seem therefore that, considered as a winner of wars, a designer of war machinery is at least as important as a general.

Gen. Von Kluck and his army made a really impressive march from the Belgian frontier to the gates of Paris, but how much of that victorious march was due to Von Kluck and how much due to some presumably spectacled and narrow-chested individual living in a perpetual atmosphere of tracing paper and calculations in the great gun works at Essen? And when the French, with their terrible "seventy-fives," achieve a victory (i. e., advance a hundred yards or so along part of their line), has not the designer of the "seventy-fives" rather more to do with it than the officer in command? It might not be too much to say that the real winners of modern battles are not soldiers nor sailors, but certain quiet civilians of a studious frame of mind.

It is perhaps a little too early to generalize at present, but, so far as this war has gone, it does not seem that the unexpected happens very much in war nowadays. A great deal of what has happened in this war was predicted a long time ago, even in detail. Hilaire Belloc's prediction of the siege of Liège, for instance, was a really remarkable forecast of what actually took place. It appears that, given all the factors, number of men, number of guns, positions occupied, and assuming equal courage and *morale* on the part of the opposing forces, the result can, in many cases, be predicted with considerable accuracy. It is stated that Gen. Joffre recently remarked that he could clear the Germans out of northern France from their present positions if he chose to sacrifice 100,000 men. It sounds like a chemist prophesying the result of mixing a given acid with a given alkali.

If it is true that as one of the lessons of this present war our military experts will be able to predict much more accurately than has hitherto been possible, the result of a contest between given forces, then there are only two factors which might disastrously upset their calculations. One would be the appearance of a Napoleon on one side or the other, and the other would be the unexpected production of some new and unprecedentedly terrible war mechanism by one of the combatants. Leaving out the sudden uprising of a Napoleon as a very improbable contingency, it suggests itself that the war could be decided without combat. For representatives of the combatants could meet and, without showing the designs, the merits of their latest mechanisms could be demonstrated experimentally. The military experts would then know exactly where they stood and the whole war could be worked out on paper. Victory would be awarded to the theoretically successful side, which would proceed to exact indemnities and do all the other things in strict accordance with usual military procedure. Only no lives would be lost. The designer who had produced the most horrible mechanisms would be called generalissimo and decorated with legions of honor and all sorts of things. He would at last be accorded his rightful place, as the real winner of wars.

War cannot be considered a science until something of this kind is done. In ordinary science we experiment to get data. Then we calculate. We have a crucial experiment now and then to test our deductions. It may be that this war will furnish us with sufficient data to enable us to calculate the results of others. Perhaps at the end of a thousand years a war, in the nature of a crucial experiment, would be necessary to test our conclusions; only by that time we imagine that humanity will have abolished real wars from quite other considerations.

## War and a Man's Duty

IT is probable, strange as it may appear, that America, in virtue of her non-participation in this World War, is more impressed by its sheer foolishness than any of the nations engaged in it. In Europe one's realization of its idiocy is largely swamped by one's patriotism. Europeans think of their men dying in the trenches, of a glorious bayonet charge, of a hundred local but intensely interesting and stirring episodes, and in their pride, rage or terror, they lose sight of the larger implications. Europe is too close to the picture to see it; too busy fighting or scanning casualty lists to philosophize. But this is America's opportunity for the inauguration of a great world-league of intellect.

The whole tribe of politicians, diplomatic and high official people of all kinds have blundered. Again and again we have had warnings of their incompetence; their failure to grapple with social problems; their ignorance of the things which count—the sciences and the arts. Surely no man who has studied these questions can doubt that a vastly improved social system is, even now, possible. But who has made it possible? Not the politicians, not the diplomatists, not the great military figures or the great aggressively acquisitive financiers. The great writers in Europe and America who, by sheer hard thinking, have shown us the possibility of a better state of affairs than the existing one, have been private individuals for the most part; men who have looked upon our present muddle and hated it with that divine hatred which endeavors to destroy in order to recreate,

We plead for the conscious and powerful banding together of all such men. There would be scientific men who are something more, men like Oliver Lodge; philosophers who are something more, like the late William James; novelists who are something more, like H. G. Wells; chemists who are something more, like Wilhelm Ostwald. These men have intelligence, sincerity, and power—the greatest power, the power of influencing public opinion. They are incomparable propagandists. We want to add to their number. Let their colleagues and rivals take a hand with them; let the scientific and artistic communities throughout the world become self-conscious; let them band together and direct their activities to the one great end.

So there would grow up, within the ostensible framework of our present self-seeking political governments, a real controlling and directing power, molding the thought of the world until the irresistible pressure of public opinion made our political leaders, our Kaisers, Emperors, Senators, and what-not, follow the lines mapped out by clear and honest thinking, thinking they have neither the desire nor ability, as their actions prove, to supply themselves. This is no Utopian dream; there are already indications that some such movement is afoot. And America, in virtue of its very detachment, can profit by this war to supply the great initial impulse.

## Electricity

**Postal Railway in London.**—A 9-foot tunnel is about to be constructed in London for the conveyance of mail. It will contain two tracks with island platforms at the eight stations from Paddington to Whitechapel, inclusive. The trains will be run without operators from distant control stations at an average speed of 25 miles per hour. At the island platforms there will be electric elevators to transfer the mails to the sorting offices.

**Electrolytic Oxygen in St. Louis.**—A number of plants in St. Louis, Mo., are producing commercial oxygen electrolytically. A 10 to 15 per cent solution of caustic soda or caustic potash is employed. Through this a current of electricity is passed and the oxygen that collects at one electrode is trapped and led off to a compressor, while the hydrogen is permitted to escape. If we, in this country, showed anywhere near the aeronautic activity of European countries the hydrogen would also be collected and used for the inflation of balloons.

**Railroad Electrification in Montana.**—Contracts have been let for the electrification of the Puget Sound Line of the Chicago, Milwaukee & St. Paul Railway, between Three Forks and Deer Lodge, a distance of 113 miles. This is the first step toward the electrification of the line from Harlowton, Montana, to Avery, Idaho, a distance of 440 miles. Should this prove satisfactory, it is planned to extend the electrified section to the coast, making a total of about 850 miles. It is believed that electric locomotives will provide much better service and reduce the operating costs over those of the present steam system.

**Electrical Energy from Canada.**—Of the electricity generated in the hydraulic power plants of Canada, just across from our border, more than half is exported to the United States. According to a report issued by the Canadian government, 1,543,464,097 kilowatt hours were produced in 1913 by Canadian companies with transmission lines spreading over the border. Of this total, 772,597,049 kilowatt-hours was transmitted over the "export" lines while 770,867,048 kilowatt-hours of electrical energy was retained for use in Canada. Of course this does not represent all the hydro-electric energy generated in the Dominion. There are stations at Montreal, Toronto, Quebec and Winnipeg that manufacture electrical energy for domestic consumption only.

**British Wireless Amateurs and the War.**—So much has been said in disparagement of the amateur wireless telegraph operator that it is a pleasure to find him coming in for some official appreciation. Wireless telegraphy is playing a very important part in the present war, not only on the European battlefields, but also in defense of the British coast, so that an appeal has been issued to amateur operators to join the Post Office staff and share in the wireless watch that is being maintained by the government. There is also a call for efficient operators in the navy and in the army, and the wireless amateur has a chance now to make practical use of the experience he may have gained at the expense of some annoyance to commercial wireless stations.

**"Ferrowatt" Tungsten Lamp.**—The "ferrowatt" is the most recent novelty in the way of European lamps. An improvement in filament process allows of abandoning the usual zigzag mounting, and the 3-foot length of filament is wound in a compact spiral so that the makeup is much stronger. The filament is mounted at the middle of a spherical lamp bulb and is held in shape by hooks arranged in circular form around the filament so as to keep the filament from falling in. Maximum light is secured in the vertical direction because the incandescent body now lies at the center of the lamp and is very compact, so that vertical lighting is said to be five times what the old forms gave, and the horizontal lighting is reduced by only 23 per cent. With a reflector, the horizontal light can be increased, however, if need be. The new lamp is about 2½ inches in diameter and is made in 25 candle-power size. It is specially good for table lighting.

**Illuminating Engineering and the War.**—In a discussion before the Illuminating Engineering Society of London, by Mr. Leon Gasker, a few weeks ago, attention was called to the excellent opportunity now offered of studying certain questions of illuminating engineering in the peculiar conditions resulting from the war. British cities and towns have found themselves turned back suddenly to the conditions of a hundred years ago, in the matter of illumination. The effect of diminished lighting seems to result in a depressing effect that keeps people indoors, checks shopping, and the patronage of the theaters. It was brought out that, instead of an increase of accidents, there has been a decrease in the past few months, because diminished lighting made the drivers of vehicles more careful. Dimmer lighting in street cars as compared with subway trains, which have no occasion to lower their lights, raises the interesting question of whether there is a greater attraction of the public to the more brightly lighted conveyance. Another interesting point is that police regulation of the lighting of show windows may result in introducing the far preferable indirect-illumination system.

## Science

**The Weather over the Western Cattle Ranges** is the subject of special daily reports which, according to the last annual report of the Weather Bureau, were inaugurated last spring and have elicited much approval. Reports from a number of points in the western Great Plains region are collected daily by telegraph at Amarillo, Tex., and thence distributed in bulletin form to the cattle and financial interests in the surrounding country.

**Suspending Mendel's Law?**—An article of interest to plant-breeders in the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT, No. 2036 for January 9th, 1915, by Dr. W. P. Jenney, describes the method followed whereby the hybrid Japanese morning glory is made to reproduce itself true from seed. The operation of Mendel's law, which is not manifested until the second generation from seed of a hybrid, is ingeniously avoided by repollenating the hybrid with the pollen of its male parent, whereby no true second generation occurs; but only a series of progressive first generations, on which the Mendelian law has no action.

**Dr. Bose's Visit to America.**—Prof. J. C. Bose, whose discoveries regarding the continuity of physiological response in the plant and animal created great interest in England and the Continent, is now in America on a scientific mission from the British government. Prof. Bose exhibited his resonant recorder at Philadelphia before Section G of the American Association for the Advancement of Science on the 29th of December. This instrument records time intervals as short as the thousandth part of a second, and measures the perception time of a plant. On the 11th of January Prof. Bose will give a discourse on "Plant Autographs and Their Revelations," illustrated by original experiments, before the Academy of Sciences, New York. Before his return to Europe Dr. Bose will lecture before the Columbia University, the Academy of Sciences, Washington; the Philosophical Society of Philadelphia, the Twentieth Century Club, Boston; the Universities of Chicago, Wisconsin, Illinois, and Michigan.

**The European Starling** (Sturnus vulgaris) was introduced into the United States about 25 years ago, and its range has gradually extended over much of New York, New Jersey, Pennsylvania, Connecticut, and Massachusetts. During its migrations in search of food it ranges much farther, being frequently found as far south as the District of Columbia. According to the Biological Survey, which has recently made a study of this bird, it will probably spread ultimately over the whole country, in spite of the fact that four states in which it exists have now withdrawn all protection from it, while its shipment from one state to another has been prohibited under heavy penalty by Congress. It appears to be an undesirable addition to our fauna, on account of its fondness for small fruit, and because it nests in tree cavities, boxes, or recesses of buildings, and is thus brought into competition with more useful native birds, such as the bluebird, purple martin, and flicker. On the other hand, the starling destroys many noxious insects and does not appear to be destructive to grain crops. In the old world, especially Germany, the starling is a favorite cage bird, being taught to whistle tunes and pronounce words.

**John Muir.**—News comes from Los Angeles of the death there, on December 24th, of John Muir, the widely known naturalist. He had been visiting his daughter at Daggett, where he was stricken with pneumonia, and removed to a hospital in Los Angeles, where he succumbed at the age of 76 years.

John Muir was born in Dunbar, Scotland, April 21st, 1838, and came to this country when 11 years old with his parents, who settled in the wilderness of Wisconsin. He secured more than the ordinary education by his own efforts, studying early and late when not engaged in farm labors, and later pursued his studies in the University of Wisconsin. His love of nature induced him to take up a wandering life, during which he covered much of the territory of the Southwest and West, constantly increasing his knowledge of natural history, as well as allied sciences. About 1876 he joined the United States Coast and Geodetic Survey to enable him to extend the field of his observations, and covered great sections of Alaska. The great Muir Glacier bears his name. He was one of the party that went in search of DeLong and the lost Jeanette expedition, and also of the Corwin expedition, during which he had an opportunity to study the glacier formation of the Bering Sea, and the coast of Siberia, and later went to Switzerland and Norway for purposes of comparison. Besides being a naturalist he was an able geologist, explorer, artist and philosopher, and in his younger years showed that he was a clever inventor. He was widely known as the "Guardian of the Yosemite" and the "Naturalist of the Sierras" from his intense interest in those regions, and he did much for the preservation of the national forests and parks. His literary work is widely known. He received many honors from institutions of learning, and was a member of a number of scientific societies.

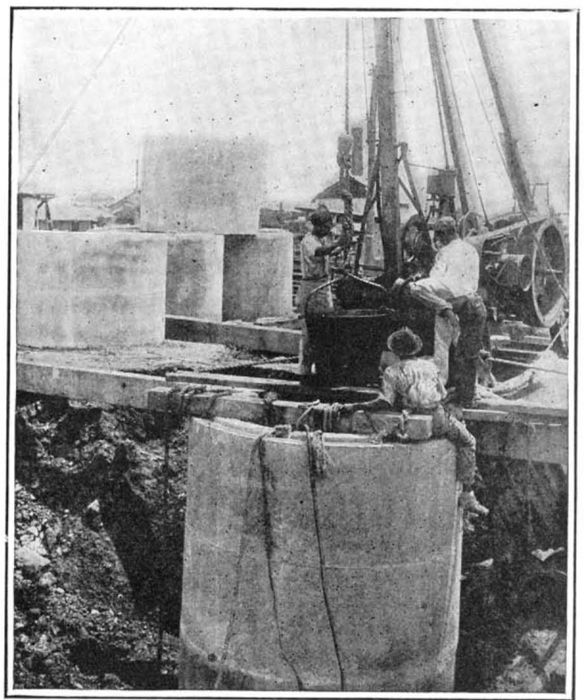
## Aeronautics

**Swiss Army Aeroplanes.**—Reports before the war stated that the Swiss government had decided upon the types of aeroplanes to be adopted for use in the army, and three makes were officially approved, these being the Blériot (monoplane), Lohner (biplane) with fixed motor and water cooling, and a type of aeroplane built in Germany according to designs of the Swiss engineer Schneider, which accounts for the preference given to it. This apparatus also has a fixed water-cooled motor. It was stated in the German press that all the aeroplanes for Switzerland were to be built in Germany, but the above statement controverts this. It is impossible to say how many machines were secured before the war was declared.

**German Aeroplanes Drop Bombs in England.**—On December 24th and again on Christmas Day, German aviators flew over England and dropped bombs. On the former day a machine appeared high above Dover and dropped a single bomb in an effort to hit Dover Castle. The bomb fell in the garden of the Rectory and did no damage. British aeroplanes arose in pursuit, but the German machines had too great a start and they were unable to overtake them. On Christmas Day a second German aviator flew over England and penetrated as far as Rochester, which is but 28 miles east of London and 7 miles from Gravesend. The bomb which he dropped fell in a road and did no serious damage. On the other hand the attack made by Squadron Commander Richard B. Davies of the British Naval Air Service on the airship shed in Brussels the day before Christmas is thought to have been successful in destroying a Parseval airship. Lieut. Davies, in his Farman biplane, flew directly to Brussels and discharged eight bombs upon his first attack. Six of these he believes hit the shed and did serious damage. He dropped four more in the second attack, but owing to the clouds of smoke which arose from the shed the damage caused by the latter could not be ascertained.

**Turkish Aviation Programme.**—According to statements published before the war, Turkey, following the example of the other powers, entered the aeroplane movement, and may even be in advance of some in the way of marine aviation. In considering the make-up of the new aeroplane fleet there was considerable competition between constructors of France, Germany and America, the last represented by Curtiss, who made a series of flights upon the Bosporus to show the advantages of his flying boat. It appears, however, that French builders came in for a good part of the orders, and the Nieuport establishment was to furnish as many as 30 hydro-aeroplanes. According to a good authority, Turkey intends to fit up three centers of naval aviation, and the above-mentioned marine flyers are for this purpose. These are of 80 horse-power, the Rhone type, the same as made such a good performance at the last French naval maneuvers and went through a series of brilliant flights at Bizerta, on the Mediterranean. It is stated that the Turkish army has already 25 pilot officers who are now in good training. Capt. De Goys is engaged in organizing both the army and the navy aeroplane service. No doubt matters have changed considerably since the war broke out.

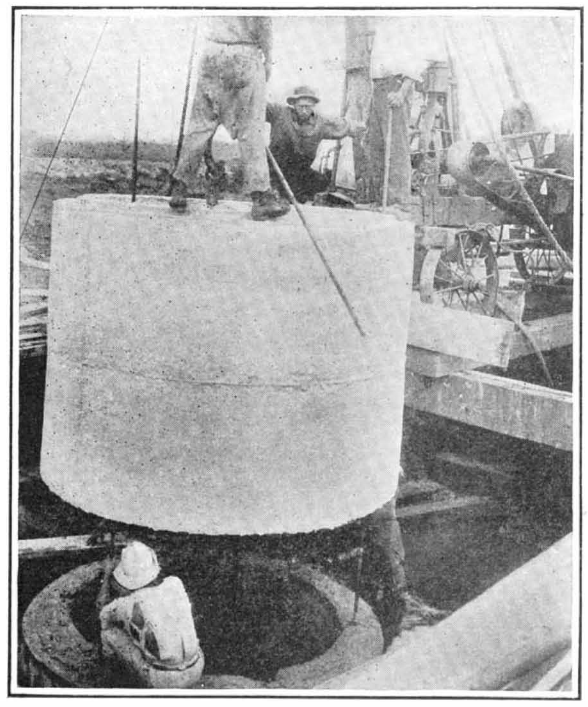
**A Successful Naval Aeroplane Raid on Cuxhaven.**—Encouraged by the former raids on Düsseldorf, Friedrichshafen, and Brussels (by Commander Davies on December 24th for the purpose of blowing up a Parseval) the British authorities carried out a similar raid from the sea on Christmas Day. Seven aeroplanes piloted by Flight Commanders Oliver, Hewlett, Boss, and Killer, and Flight Lieutenants Miley, Edwards, and Blackburn, participated in this raid, which was made off Heligoland from two British cruisers and several destroyers and submarines as a base. The water craft managed to thread their way successfully through the mines and to get within a short distance of the coast, where they remained for three hours without being fired upon by the German forts or warships and where they safely re-embarked three of the seven hydro-aeroplanes with their occupants, before returning home. Three other aviators returned to their base and were picked up by submarines, which afterwards sank the aeroplanes so that they would not be captured. Flight Commander E. T. Hewlett (a son of Maurice Hewlett, the novelist) was the only one who did not return. His machine was found wrecked some eight miles of Heligoland and its pilot was thought to have been lost. As soon as the ships had arrived off the coast in broad daylight, but under foggy weather conditions, the seven aviators took flight with the purpose of dropping bombs upon various points of military significance on the mainland. The Germans state they did no damage beyond setting afire a gas tank at Cuxhaven. They repelled the attack with their own aeroplanes and a couple of Zeppelins; but once the latter had received a few shots from the aircraft guns of the "Undaunted" and the "Arethusa," they withdrew and did not any longer risk destruction. The Germans claim that they suffered no casualties, so that the fight was a draw except that it awoke Germany to the fact that she is quite in danger from the attacks of British aircraft.



Top of one of the hollow concrete caissons forming piers for the Balboa docks.

# The Balboa Docks

## How the Solid Masonry Columns for Supporting the Great Wharves at the Pacific Ocean Entrance to the Panama Canal were Rapidly and Economically Constructed, Carrying the Foundations Down to Bed Rock



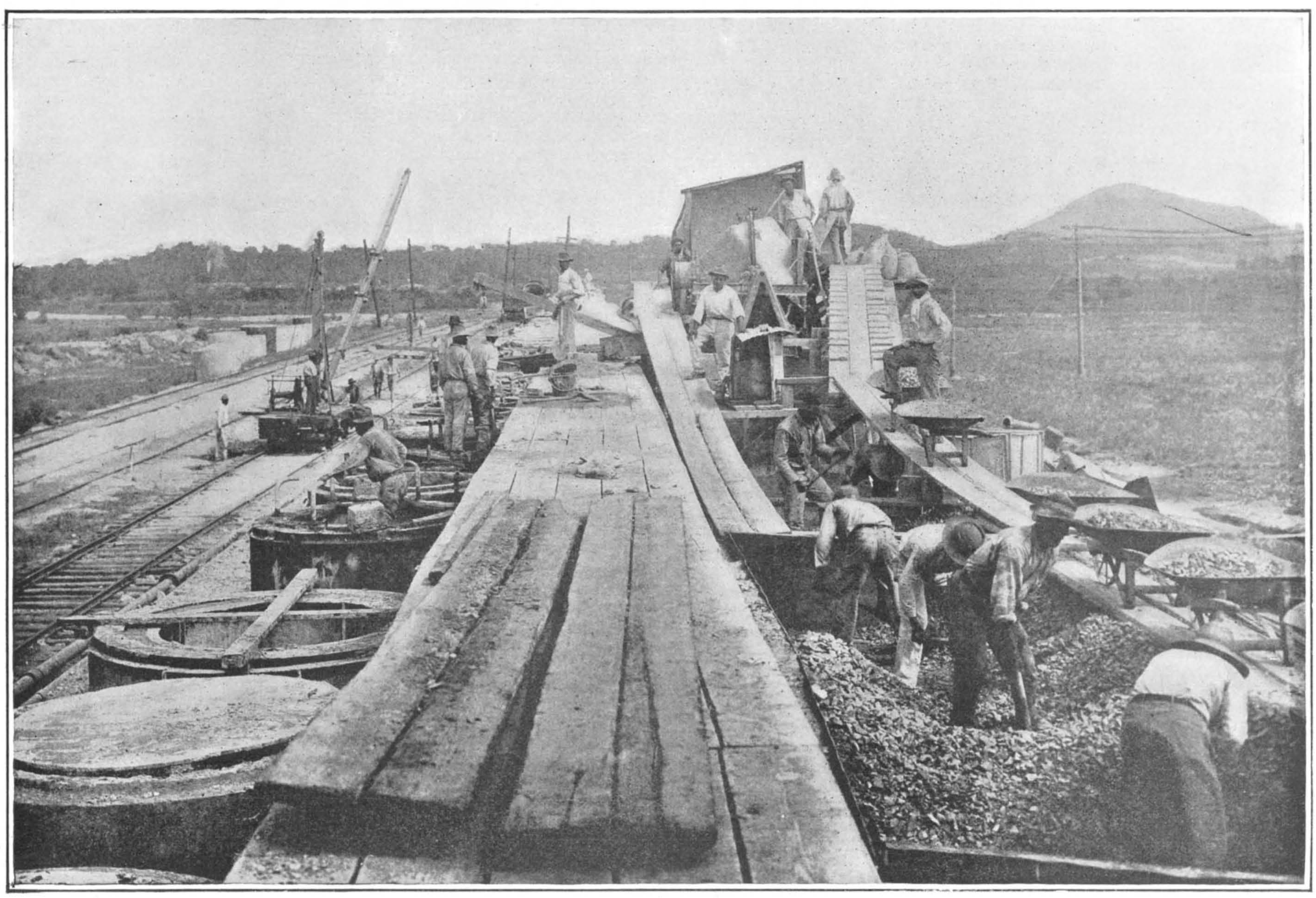
Adding a new section to the concrete caisson that is to form a pier for the Balboa docks.

THE operation of a great canal like that at Panama necessitates the construction of extensive auxiliary works. Thus, at Balboa, on the southern or Pacific terminus of the great waterway, extensive wharves and piers are being built. As some of the loads to be carried are very great, it has been deemed advisable in general to carry the foundations to solid rock. This is by no means one of the easiest of engineering problems because of the necessity of combating the water. The surface of the soil is, in part, actually covered with water, and the soil itself is pretty much everywhere permeated with it. The method of reaching the rock through water-bearing material pursued in New York city, in the construction of the foundations of the great skyscrapers in the extreme southern end of Manhattan Island, is to use the pneumatic caisson. This is a very sure method, but it is also decidedly expensive. At Balboa a caisson is employed, but it is open at both ends. Large shells of concrete, 7½ feet in diameter, each 6 feet in height and open at the end, are first constructed. They are the sectional parts of what will be long cylinders reaching from the rock up to the desired level. The method of procedure is to set up several sections, one atop of the other, the bottom one being fitted with a metal edge and having somewhat different dimensions. If the ground is quite soft the shell will enter a shorter or longer distance into it simply because of the effect of gravitation; however, an orange peel bucket is employed to dig away the material from the inside. As this is dug away, and additional sections of shell are added above, the caisson will sink deeper and deeper, until at last it reaches rock. Sometimes caissons of the general description of those being sunk at the Isthmus stick in the earth and give a great deal of trouble. For example, when a caisson is being put down there may be less resistance on one side than on the other, this circumstance resulting at times in tilting the whole caisson, and it is very apt to stick. Again, the cutting edge may be going down easily and rapidly when suddenly one side comes into contact with a boulder. However, at Panama, in one month thirty-one caissons were successfully carried to rock at an average depth of 60 feet.

The caisson sections have a wall thickness of 1 foot, so that there is an opening of 5½ feet in which to work the orange peel bucket. Each section of the caisson weighs about 4 tons, so that it is necessary to provide a powerful apparatus to lift them into place for sinking. An ordinary caisson from rock to surface will contain ten or eleven sections.

When a complete caisson has been sunk to rock and its interior entirely freed from earth, it is ready for its filling of concrete, which converts the whole into a solid 8-foot column, reaching all the way to the rock, and thus affording a strong foundation for the wharves and piers.

As a great many of the concrete sections had to be made, steel forms were employed, which may be used over and over again. A concrete mixing plant, operated by a steam engine, was established on



Making concrete caisson sections for the Balboa docks.

a flat car, running on a temporary track, and the concrete was run into the hollow piers through a tube, which could reach several piers from a single location of the mixing plant.

An idea of the heavy service to which the docks at Balboa may be put may be gathered from the fact that at one point the wharf will carry two great coal unloaders. These are tower-like structures 150 feet tall, each moving on a double track between which a regular railway track is arranged. Each tower carries four steam engines and a hopper, which may contain as much as 50 tons of coal.

## Notable Salvage Work Upon the "Empress of Ireland"

By Robert G. Skerrett

ALTHOUGH lost some months ago, salvage work on the ill-fated "Empress of Ireland" has only recently drawn to a close in the St. Lawrence River. Probably no sunken wreck has presented a more difficult task for the salvors than this ship. Originally, the Canadian government employed a Canadian organization which made use of facilities developed by Mr. William Wallace Wotherspoon, the well-known salvage expert. The latter personally attended to the work, and was a potent factor in its success, although the fullest credit must be given to others, and acknowledgment must be made to the splendid services rendered by the British naval divers who assisted in the hazardous tasks of recovering the bodies of the dead as well as the mails and the silver bullion stored in the specie room.

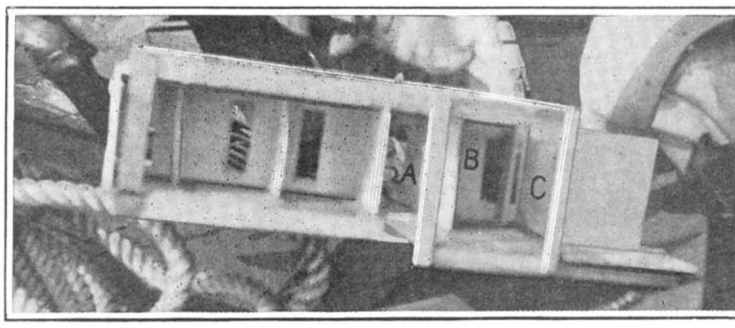
At the particular point on the St. Lawrence where the "Empress of Ireland" went down the water is quite 138 feet deep to the surface of the soft mud bottom, and high tide increases this by quite 14 feet. This means a very strong current, especially at ebb tide, and imposed a working period of but 30 minutes at each slack tide twice a day. Apart from that, the water was so cold that the divers' hands soon became numb, and to protect them it was necessary to employ rubber mitts. These were of American make and thin enough to enable the diver to guide himself by his sense of touch—something upon which he has to depend very largely in deep and dark waters.

After sinking, the "Empress of Ireland" partly righted herself, then heeled over at a very sharp angle, and settled deeply into the mud of the river bed. This added greatly to the perils of the work and made especially hazardous the operations incident to getting through the steel side of the craft and following a devious route into the ship's strong-room. These efforts required that the divers should work at the very unusual depth of 160 feet inside the body of the foundered liner, and, to make them familiar with their objective, they were previously schooled by means of a cardboard model of the internal structure along their route. Further, that their risks might be lessened, flanking doorways and one wide passage were bulkheaded off in order that the men should not go astray nor their hose, lifeline, or telephone connections become entangled.

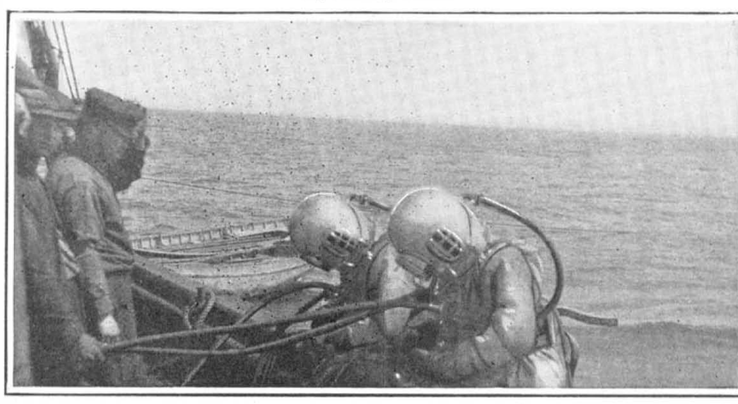
The telephone played an important part in the operations. This telephone gear was of English design, but somewhat improved by American telephone engineering practices. Because of the dangers involved, the divers worked always in pairs; and as soon as one couple came to the surface two more men were immediately ready to carry on the work. One of the best things done was that of drilling into the side of the ship and cutting an ample passageway. The men worked upon a piecework basis, and they pushed ahead so rapidly that their rate was but little short of that ordinarily deemed excellent at a shipyard and in the open air.

The salvage craft was provided with a compressed air system, and the divers received their air from storage tanks instead of from pumps, as is the common custom, and there was also a hospital or decompression tank such as is used here in the United States in foundation work for skyscrapers. The diving was carried out agreeably to the practices prescribed by the British Admiralty, after certain well-known scientific tests, and while the unusual number of twelve divers were engaged upon the job only one man lost his life. He, unfortunately, slipped from the side of the sunken liner and dropped into much deeper water. The sudden application of hydrostatic pressure confused him, and in his excitement, instead of opening his air valve, he screwed it closed, and actually broke off the little hand disk! After that fatality every valve seat was notched so that air would reach a diver in distress and keep him alive until aid could be sent to him, no matter if he did jam the valve by mistake.

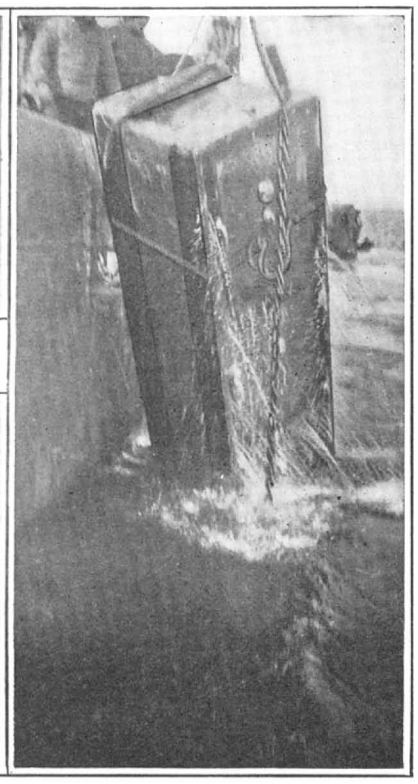
All of the bodies were recovered that could possibly be reached, and this was really the prime concern of the officials of the Canadian Pacific Railway; also the bullion and specie in the strong room were salved; and up to date substantially most of the mail pouches have been brought to the surface. In addition to this, the steel masts of the "Empress of Ireland," which were a menace to navigation, were cut away with air drills. This entire undertaking marks a notable advance in deep-water salvage operations, and shows that even the dangerous conditions on the St. Lawrence will not daunt determined men when guided by thoroughly competent experts.



The cardboard model. *A*, the blocked alleyway; *B*, door to mail room; *C*, strong room.



Because of perils involved the divers went down in pairs.



Bringing up the purser's safe.

**Notable salvage work on the "Empress of Ireland."**

## The Highest and Lowest Temperatures in the Atmosphere

THE classic example of extreme hot weather is the temperature reading of 127.4 deg. Fahr., recorded at Ouargla, an oasis in the Algerian Sahara, on July 17th, 1879. It must not be supposed, however, that this is the highest temperature ever known to have occurred in the atmosphere. It is merely the maximum ever measured by the shaded thermometer of a regular meteorological station. In the interior desert region of New South Wales the traveler Stuart once measured 131 degrees in the shade. Griffiths, in his "Travels in Arabia," mentions having observed the heat during land winds to reach 132 degrees in the shade, and 156 degrees in the sun. In this connection it should be remarked that readings of a thermometer "in the sun" are entirely unreliable, because the instrument is directly heated by the sunshine, and no longer records the temperature of the air around it. In the Northern Circars (India) the temperature on one occasion is reported to have stood at 108 degrees at *midnight*, and at 112 degrees at 8 A. M. Night temperatures of 100 degrees and more are common in the Arabian desert. The most extraordinary shade temperature on record is 167 deg. Fahr., said to have been observed in the Desert of Gobi, but this observation is certainly questionable.

At the opposite end of the scale we have the famous reading of 90.4 deg. below zero Fahr. recorded at Verkhoyansk, Siberia, January 15th, 1885. This often quoted record has, however, been beaten recently at the same place, with a reading of 97.6 degrees below zero. The excessive cold prevailing in this part of Siberia in winter is the more remarkable when we consider that the same region occasionally has temperatures as high as 88 degrees above zero in summer—a range of 186 degrees! The summer is about two months long, and its hot days thaw the ground to a depth of about 3 feet. Verkhoyansk would be uninhabitable in winter, but for the fact that it never experiences much wind at that season. Another "winter cold-pole" appears to lie over Nova Zembla. A minimum thermometer left here by an Austrian expedition in 1872 was found many years later to have registered a temperature of 95.8 degrees below zero. The lowest average temperature throughout the year is found in Antarctica, though the winter temperatures here do not fall so low as those above mentioned. The minimum individual temperature reading thus far reported from the Antarctic is 73.3 degrees below zero, observed by Amundsen's expedition on August 13th, 1911.

The absolute minima of temperature heretofore measured in the atmosphere were not, however, found near the earth's surface, but at an altitude of several miles, and the measurements were obtained with self-registering thermometers attached to "sounding balloons." The "record" up to date is 133 deg. below zero Fahr., and, strange to say, this extremely frigid temperature was found about 10 miles above the Island of Java, only a few degrees of latitude from the equator. A temperature of 119 degrees below zero has been measured almost exactly over the equator in Central Africa, at an altitude of 12 miles.

## Amole

ONE of the natural resources of the sandy portions of the Great Southwest is used to great advantage, mostly by the native Mexicans, in their process of laundering woolen goods of fine texture.

A species of cacti, native of New Mexico, often taken in common with several other species of cacti, which have detergent properties, under the head of amole, but more scientifically known as the species lechuguilla (*Agave heteracantha*), abounds in practically inexhaustible quantities throughout the southern portion of New Mexico.

Its sword-like leaves contain many minute pores, which absorb moisture from the atmosphere, thus giving life to a form of vegetation which otherwise could not exist in our arid belt and sand dunes. These leaves also protect the plant from its enemies, which are so numerous toward this particular species because of a sweetness of its sap, which, when extracted, will rapidly vanish down the throat of any cow or calf which is in close enough proximity to be attracted by its odor.

Below this cluster of "sword-like leaves," and usually about two or three feet from the ground, is a trunk of fibrous form, and below this an anchorage of very tough fiber roots, usually very short and stumpy.

The trunk part, which extends away into the ground before the roots branch off, is the part used by the Mexicans for its soap-giving properties.

By the use of the axe the leaves and upper portion of the trunk are cut off and thrown away. A hole several feet deep is dug around the lower portion of the trunk. The plant is then cut off just above the roots. The outer bark, also of a hard fiber-like composition, is peeled off and the remaining fibrous tissues are placed in the open sun to dry. After it is thoroughly dried it is then cut into small chunks or pulverized into a powder, wrapped in a cloth and placed in the wash tub or vessel in which the woolens are to be washed. After boiling for several hours a wooden paddle or stick is used to stir the mixture until a thick lather is formed.

The clothes to be laundered are then placed in the mixture, and in case of woolen goods allowed to soak over night. The usual method of rubbing on a board or corrugated piece of metal and rinsing in clear water is then followed.

Woolen goods, especially sweaters and the like, which are washed with amole instead of ordinary soap, will come out like new, their texture soft and silky and every thread thoroughly cleansed. No shrinking ever accompanies this process. It is for this reason mainly that it is used by the Mexicans in washing their beautiful and finely colored hand-made woolen blankets and serapios.

**The Work of Exploring the Upper Air with kites** and balloons heretofore carried on by the Weather Bureau at Mount Weather, Va., has been transferred to Drexel, Neb.

## Rebuilding Edison's Great Plant

An impressive example of American inventive faculty, combined with mechanical efficiency and organization, as found in a large plant maintained and operated under the best of modern conditions, is shown in the reconstruction of the plant of Thomas A. Edison, Inc., at West Orange, New Jersey, after the disastrous fire, which occurred on December 9th, 1914. While the name of Edison and many of his inventions are of course household words, the general public does not appreciate that with his inventive genius there has been coupled an effective system of organization and administration, not merely of one large industry, but of a group of industries engaged in the large scale manufacture of such dissimilar products as phonograph and records; electric primary batteries; kinetoscopes and motion picture films, both for exhibition and for the household; dictating machines; kinetophones; alternating current rectifiers; and house lighting controllers. Not only are these the inventions of a single master mind, but they have been manufactured virtually through a single organization, under the control of the inventor himself, with facilities adequate to undertake not only the assembly of various parts, but also their complete manufacture, from often the crudest raw materials. Therefore, economically, as well as from the standpoint of structural engineering, a fire damaging some eleven buildings and extending over an area of nearly six acres must be regarded as an important conflagration, particularly when the total loss is well in excess of a million dollars. But such a disaster, when it befalls a well-organized American plant, is but a test of its strength, efficiency, organization, and power of recuperation, and once again we have this illustrated at the Edison works. So little was the great inventor discouraged that before the ruins were cold he had assembled his engineers, ordered the clearing away of the débris, and the reconstruction of the great plant furnishing employment to thousands.

Phoenix-like there is being restored from the ashes in West Orange a group of buildings in which the lessons of the fire have been applied, while with cement made at the Edison works, and with plans of buildings produced by members of his own staff, there will soon be in evidence a group of factory buildings that will practically be models of modern construction. Although reinforced concrete is usual for a modern factory building, in how many cases can the cement be produced by the same owners and mixed and cast under the direction of their own engineers?

In putting in order this large and remarkable plant naturally the first consideration was the buildings structurally damaged the least. In these the intense heat had broken through the windows, and with large glass exposures not protected by wire glass considerable damage was done to the building as well as the total destruction of the contents. This defect in the original construction was far from good practice, which would have required wire glass. Accordingly, the first step in the reconstruction was to provide metal sash and wire glass for the burnt-out buildings, and the phonograph record building was the first to receive attention, some 125 new windows being provided within three weeks. This illustrates the promptness with which such construction can be undertaken. On December 12th a leading firm manufacturing metal window frames received an order for a regular factory type sash with light 12 by 33 inches, each bay of the walls being equipped with three swing sections. Six days later the first portion of the sash was shipped from Youngstown by express, delivered at Orange the next day, and the following morning some sections were erected. By January 1st practically all sash in this building had been erected and the glazing with Syenite wire glass was under way. In the meantime the buildings had been cleared and put in readiness, so that their regular use was only a matter of a few days.

In other cases where the columns and floor beams had shown failure, due to the unusually hot fire, these columns were immediately repaired with the cement gun, two complete outfits having been leased for this purpose, and the cement deposited wherever possible, and especially as soon as the reinforcements had been completed. Of course where the buildings were brick or frame the loss was complete, and these will involve total replacement, which in many cases will add to the convenience and symmetry of the plant as well as its safety.

While it is impossible to entirely avoid fire hazard in a factory plant, especially in a congested group of buildings, each housing some branch of an industry, especially where inflammable materials bulk large, yet there are ways of localizing such dangers, and confining the damage to a single floor or structure. In the Edison buildings the old group comprised various types of construction. The new buildings will comprise but one, namely, the best, with metal sash and wire glass at all exposed openings, with fire doors and adequate sprinkler systems. This equipment takes into full recognition the fact that even the most fireproof building, if filled with combustible material, must be regarded simply as a stove in which the flames are confined until they find some point of egress sufficiently big to break through.

Thus it can be seen that even a disaster like this is but temporary in its effect. In manufacturing, as in other commercial undertakings, capitalized brain power, be it in the form of patents, systematic organization, able administration, or the collective minds of trained technical workers, is an asset far greater than bricks, mortar, cement, and machinery, for these qualities always will rise superior to temporary misfortune. Added to this we find in the Edison works the same wonderful power of enterprise that enabled its chemists to make its own chemicals when the war cut off the foreign supply, and the fact that unscathed through the fire came the laboratory of the inventor with its priceless records and experiments in progress. With the nerve center unimpaired, other members of the body soon again can be made to function, and it is only a matter of a few months before the product of the Edison laboratories will be at its customary output, while new inventions will add to the list of its activity.

## A Formula for Calculating the Tactical Value of Fighting Ships

By A. Given

The descriptions of fighting ships as given to the public generally cover displacement, speed, main battery, secondary battery, armor protection, and number of torpedo tubes. To these are sometimes added the bunker capacity and size of torpedoes. These are enough to enable a naval officer to judge very closely the value of any given ship as a tactical unit, but to the unprofessional mind the very number of necessary details are confusing.

It is wished herein to present, tentatively, a method by which, from the above details, the tactical value of a ship can be calculated for purposes of comparison. It is based upon the four factors of gun-power, depending upon the size and number of guns in the primary and secondary batteries; protection, which includes the main armor belt, secondary armor, and protective decks; speed, as modified by coal capacity, which means ability to keep the sea; and torpedo offensive power, influenced by number and size of torpedo tubes. The calculation is as follows:

1. Gun power.
   - *a.* Primary battery.
     Multiply the square of the caliber in inches by the number of guns.
   - *b.* Secondary battery.
     Multiply the square of the caliber in inches of each size by the number of guns in each class. The sum of these products constitutes the units of value for the secondary battery.
     The sum of the units of the primary and of the secondary batteries constitutes the factor of gun power.
2. Protection.
   - *a.* Primary armor.
     Multiply displacement, in thousand of tons, by inches thickness of main armor.
   - *b.* Secondary armor.
     Multiply displacement, in thousands of tons, by average thickness, in inches, of secondary armor.
     Note: When only one thickness of armor is carried, multiply displacement by twice the thickness of armor.
     For value of a protective deck armor, multiply displacement by thickness of deck armor.
     The sum of the units of primary and of secondary armor constitutes the factor of protection.
3. Speed.
   Multiply the speed in knots by hundreds of tons of coal capacity. Where bunker capacity is not given, assume 1 ton coal for each 10 tons displacement.
   This factor can be applied in the same manner to submarines, but the speed in knots should be the average of the surface and underwater speeds.
4. Torpedoes.
   Multiply the number of tubes by the diameter. Where the diameter is not known, assume 21 inches.

The sum of the units of these four factors gives an approximation of the tactical value for purposes of comparison.

Applying the above formula to fighting ships described in a recent number of the Scientific American, it is found that a super-dreadnought of the "Iron Duke" class shows a tactical value of 3,426 units; the "King George V," 3,128 units; the original "Dreadnought" class about 2,570 units. Semi-dreadnoughts of the "King Edward VII" class show 1,960 units; while predreadnoughts of the "London" class have only 1,632 units. Likewise a scout of the "Chatham" class has a value of about 483 units; and a destroyer of the "Mohawk" type shows 105.4 units.

For purposes of comparison, the French super-dreadnoughts of the "Jean Bart" class show a tactical value of 3,780 units; the German "Kaiser" class, 3,088 units; and the Austrian "Viribus Unitis," 3,118 units.

## The Sewage Purifying Plant at Ostend

Ostend, Belgium, has a modern plant for purification of sewage, and it is of interest not only on account of the method employed, but also from the construction of the plant, which is carried out on the Hennebique system of reinforced concrete. The Ostend plant is largely subsidized by the state and is designed to treat 200,000 cubic feet of sewage per twenty-four hours. It is the largest works in which the Vial process is employed. The layout includes a first basin of 60,000 cubic feet for receiving sewage which comes in at night, then come four clarifying basins and a steam plant which will be further mentioned.

The works consist of two wings connected by a central building, forming a court in which is located a smokestack 140 feet high. The right wing is a building of over 1,000 square yards area, which contains the receiving basin, and situated on the second floor. This basin occupies the whole of this floor and has 8 feet depth of water. On the ground floor are four "Vial" system tanks. In this system the tanks are used to set up a circulation of water, chemicals being first added to it. The reservoir, of reinforced concrete, is divided into smaller sections or cells by cross partitions of the same material, which extend from a slight distance below the level of the sewage in the tanks nearly to the bottom of the same. By arrangement a thin sheet of chemically-charged water flows over the partitions and travels at a certain speed above the main masses of water which are stationary in the cells. The water in this small stream or sheets precipitates its solid matter due to the action of the chemicals, and such particles drop to the bottom of the tank, to be thence pumped off to the sludge tanks. In due time the entire contents of the tank undergoes this circulation and precipitation process.

The first set of tanks collect nearly all the sludge deposit from the water and the remaining tanks finish the process. It is to be noticed that the complex shapes and variable sections of these basins could not be readily or economically constructed except in reinforced concrete. The inclined bottoms of the basins are calculated for loads that reach 600 pounds per square foot. In the middle building are the quarters for handling the lime, which is the reagent generally adopted for precipitating the water, and it is said that the Vial method secures much better results than has been obtained heretofore by lime treatment. The distributor is composed of a drum of wire gauze into which powdered quicklime is introduced, which breaks up and sifts the finely divided lime into a vessel placed just below and having four hoppers. In the bottom of each hopper is a vertical screw driven by a pawl, which serves to feed out the lime, and at each turn of the screw a given and constant dose of the lime powder is dropped into a tank of water provided with a stirring device. Thus milk of lime is formed, which then goes to be mixed with the sewage, in the settling basin.

In the left hand building are the boilers, the 50 horsepower engine, dynamos and electric fittings, as well as the Robatel centrifugals for concentrating the sludge and the Huillard apparatus for drying it. The centrifugal machines run at 1,000 revolutions per minute and act to thicken up the sludge and bring it to the state of paste, then screw conveyors take it to the dryers, which are heated by waste gases from the furnaces. An endless belt of wire gauze runs through the sludge paste and, becoming charged with it, passes into a chamber in which hot furnace gases circulate, so that at the end of the course the wet material is dried and can be removed in the condition of fine powder. This is transported by a conveyor to the second floor, where it is prepared for shipment as a fertilizer.

On the top floor are the water tanks for boiler feed and for cleaning purposes. Here are also placed tanks which receive the sludge coming from the main settling basins, and it is delivered hence to the centrifugators.

**Ozone Water Purifying.**—The city of Nice is making use of two large plants for purifying water on the Paris Otto ozone system. First there was erected an ozone sterilizing plant at Bon Voyage, which handled 675,000 cubic feet per day, and as this was found to be most successful, the next step was to put in a second works at Rimiez, and at the present time the city is entirely supplied by ozone-sterilized water. Power for the first waterworks comes over an electric line using 3-phase current at 10,000 volts and belonging to a local network, while in the second plant the water supply is obtained under conditions which allow the hydraulic power itself to furnish all the power needed for the current.

# War Experiences of an Air Scout—III*

## A Battle in the Clouds

By Frederick C. Hild, American Volunteer With the French Aviation Corps

THE next morning at 8 o'clock I was ordered to duplicate the flight I had made the day before. The day being a hazy one, it was quite difficult for both the observer and me to see the activity upon the ground beneath us from our established elevation of 7,000 feet, so I descended to a level of 4,000 feet, which made my flight a rather dangerous undertaking. We covered nearly the same ground as we had on the day before, with excellent results; but the fact that I was not brought down by the enemy's guns was a wonder, since terrific rifle and machine gun fire must have been directed against my apparatus. Examination of the wings and body showed where they had been penetrated by six bullets. A small circle, drawn by crayon, around each hole, together with the date and time of my flight, served for future reference. The weather was beginning to get extremely cold, which made flying at high altitude a rather cold proposition; so I was quite happy to have again alighted after flying 1 hour and 15 minutes.

**Dodging Among the Clouds.**

In the early part of the afternoon on the same day I was ordered to make my third flight over the battling armies. This flight very nearly proved to be my last flight upon this earth. The sky was then cloudy, which proved to be a rather excellent time for both observation and bomb-dropping, as it enabled us to fly at a ridiculously low height with comparative safety from the enemy's rifle and machine-gun fire, my apparatus being obscured from time to time by the low-lying clouds. After flying about a half an hour at a 3,000-foot altitude, we sighted the enemy a few miles away, and the observer who accompanied me proceeded to get ready to dispatch a thousand of the little death-dealing steel darts that we had been directed to take along. My apparatus was then dashing in and out of the clouds, which presented a rather difficult target to the enemy below. As a rule, when an enemy's flying machine is sighted the gunners on both sides are on the lookout for it. In the early days of the war French airmen were shot down by mistake by French gunners, who fired at nearly every aeroplane they sighted. To prevent this, all the French machines had the national colors painted beneath each wing. The German machines were likewise designated; but at a height of 6,000 feet the flag is invisible, and it is only by their shape and the direction from which the apparatus is coming that the two types of aeroplanes are detected. Flying at only 3,000 feet our machine could have been easily seen and detected; but the fact that we were nearly all of the time obscured by clouds either prevented our detection or fooled the Germans into believing that it was one of their own apparatus.

**A Shower of Steel Darts.**

Suddenly through an opening in the clouds we sighted about 20,000 Germans directly beneath us, on the march. My observer immediately dispatched the steel darts on their deadly errand; but with what result we were unable to ascertain. Almost instantly we were obscured in another cloud, and by turning the machine sharply to the right, which nearly threw out my observer, I instantly changed my course and fooled the thousands of Germans below, who must have emptied their rifles into open space in an endeavor to avenge the murder of many of their comrades that my apparatus must have caused.

**A Fight in the Sky.**

Having finished my errand, I proceeded to return to headquarters, steering by compass, and at the same time congratulating myself upon getting away safely from the most dangerous position I was ever in. Then I pursued a downward grade in order to get out of the clouds and ascertain whether my compass was guiding me correctly. This proved to be nearly the end of my activity with the French government, for a few moments later I sighted one of the famous German machines, an Etrich Taube. Being over-stimulated with our previous success, I decided to give chase, though both the observer and I were armed merely with a revolver apiece provided for just such an emergency. My apparatus, being capable of making 90 miles an hour, soon caught up with the German machine, who upon seeing us had headed for a bank of clouds, and my observer was just getting ready to fire, when suddenly there appeared from the bank of clouds another German machine of the biplane type, which immediately opened fire upon my apparatus with what looked to me like a machine gun. Of course, no sound could be heard above the roar of my motor. Being unprepared for such an attack, immediate action was necessary. The German armored machine was now nearly over our apparatus, while the Taube had since turned about and was coming straight for us. Our position was most dangerous and for a second it looked as though we would soon be dashing headlong into space. I then did the only thing possible; pushing my elevating lever forward my apparatus dived head first so steeply that it nearly turned upside down, and in a moment I was a thousand feet away, quite low, but, fortunately for both of us, we were well behind the German lines and over country where there were few or no German soldiers to be seen; otherwise we should have been facing further difficulties to hamper our escape.

The Fabre device for dropping bombs from an aeroplane. Note the sights.

Photographs by Levick.

French mitrailleuse firing at a German aeroplane.

**A Race for the Shelter of the Clouds.**

Upon arriving at the bottom of our steep descent, I leveled out my machine and soon left the German machines in the rear. Evidently they had thought that their rifle fire had found its mark and brought us down. Upon seeing that our machine was again flying normally, they gave chase immediately, but the tremendous speed of my monoplane soon outdistanced both of them. As I had been gradually climbing throughout the chase, I soon regained my normal height and faded out of sight into the welcome clouds. Again I headed my apparatus toward the French lines. This time I maintained my altitude and was quite satisfied with an occasional peek at the ground below, through the opening of the clouds, to ascertain my direction. It seemed hours to me ere we were again flying inside the French lines, where it was quite safe to lower my apparatus from our obscure place of hiding. A most welcome sight to both the observer and me were the hangars upon the aviation field that loomed up in the distance, and a few minutes later our apparatus was rolling over the ground after flying for nearly two hours, and the most thrilling and exciting two hours that either my observer or I had ever experienced. Further flying that day was out of the question for either of us; in fact I was all in, and it was really a wonder that I was able to return safely after our mad plunge for life.

**Shortage of Machines.**

My experiences up to this time were most exciting and thrilling and I enjoyed them immensely; but, sad to say, they were short-lived. I was sent for by the captain, who informed me that, through a shortage of machines, my Morane-Saulner monoplane would be taken over by one of the officers, and that I must again return to St. Cyr to await the arrival of a new apparatus. It seemed that the officer in question had broken his machine that day, when a stalled motor made it necessary for him to land on rough ground, and immediately he made application to the captain for a new machine. Since I was not an officer and merely an ordinary soldier pilot, I had been chosen as the victim. I was greatly discouraged and appealed to the commander, but to no avail. If that was the military system in France, I decided that I was through as far as rendering any more assistance in my capacity was concerned.

I returned that night to St. Cyr; two other pilots who shared the same fate as I accompanied me. Arriving at St. Cyr the following morning, I reported to the captain for another machine, but he informed me that I was to await my turn, and as there were about thirty pilots there waiting for Morane-Saulner monoplanes, which were being produced at the rate of about six a week, I figured it out that it would be a month before I would get another chance to go to the front. Getting into conversation with the pilots on the waiting list, I discovered that many of them had suffered the same fate as I had, at different points along the front, and nearly all in the last couple of days. The throwing out of the Blériot, Rep, Deperdussin, and Nieuport monoplanes increased the number of pilots for the Morane-Saulner monoplane; the output of the manufacturer did not meet the demand.

**Honorable Discharge.**

I secured an interview with Capt. Duperron, who had been transferred from Tours to St. Cyr, the headquarters at Tours having, since I had departed some days before, received the order to dismantle and move to St. Cyr and Avord, where future operations would be carried on. I laid my case before him in detail, and when he told me confidently that it would be many weeks and months before there would be an abundance of machines to go around I requested of him my discharge; and in order to have some substantial excuse on which the action of the Minister of War would be based, I

(Concluded on page 58.)

# Measuring Human Intelligence

## A Progressive Series of Standardized Tests Used by the Public Health Service to Protect Our Racial Stock

By Howard A. Knox, Assistant Surgeon, United States Public Health Service, Ellis Island, N. Y.

The Moron test should be done by ten-year-olds without difficulty. Extra pieces are shown alongside for purpose of illustration.

The geographical or jig-saw test. Can be done by seven-year old children if they are normal mentally.

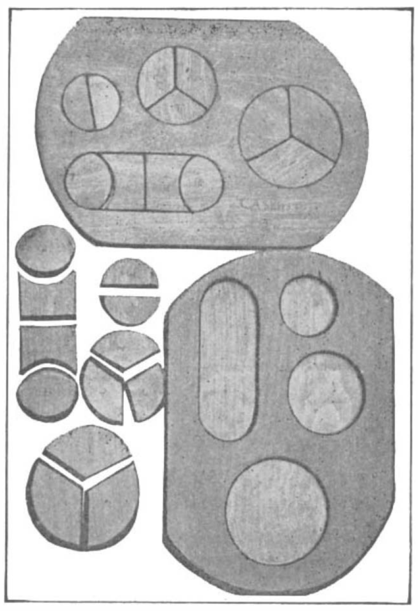
Leaf cluster comparison test. There are ten clusters arranged in five pairs; the members of each pair, numbers and letters corresponding, as 1-A, 2-B, etc., must be exactly alike in principle at least. The examiner can draw the clusters sufficiently well for practical purposes with a pen. The examiner points to cluster "1" with a pointer and asks the subject to indicate the other one like it with his pointer.

The inkblot imagination tests. The subject is asked about each blot, "What does this look like and what does it remind you of?" The answers given should be logical and sensible, and it would not be so to call "1" a tree or a star, but it would be quite reasonable to call it a snake, a river, or a pennant, and it would also be well within the realm of sense to call "2" a bear, "5" a house or a hat, and "6" a butterfly or an umbrella. (Imagination is an important possession, no great achievement was ever accomplished without it.) Many defectives, having no imagination at all, will say, "I don't know" about each blot excepting perhaps "1" and "3," which are very easy.

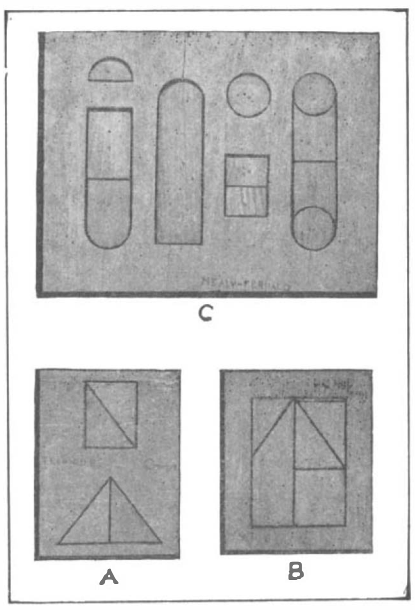
A MAN or woman who succeeds in life is mentally more energetic, better able to remember, more attentive, less open to evil suggestion, has better judgment and is less liable to brain fag than one who makes a failure of his opportunities. These qualities and a few others of lesser importance constitute the thing we know as intelligence and the quality and quantity of this that we possess is largely determined by heredity; in short, making allowance for favorable opportunity and environment, we will be pretty much the same kind of man or woman as our parents and ancestors have been, and we are then a composite of them. We are liable to suffer from the same emotions as they, and we are liable to obey the same impulses and inclinations, and it is for this reason that habitual crime is really an inherited disease, and it is for this reason that the law providing for life imprisonment for habitual offenders is a good one. The tendency toward crime may exist in the presence of a brilliant intellect, as it very frequently does, and we are unable to detect it with any degree of accuracy; the measuring scale to be given further on only determines the intellectual power, that is, the ability to think, to reason, to judge, to adjust one's self to the social requirements of the world around him and to exist harmoniously in it, in conformance to its laws and customs, exclusive of vicious tendencies, **which last cannot be detected by the mere gaging of the intelligence.** The mental enfeeblement which can be determined by the scale does not take into account the cause of the enfeeblement, which may be anything from alcoholism to actual insanity in the one being tested to these same conditions in one of his great-grandparents—in other words, faulty heredity.

The purpose of our mental measuring scale at Ellis Island is the sorting out of those immigrants who may, because of their mental make-up, become a burden to the State or who may produce offspring that will require care in prisons, asylums, or other institutions. This same measuring scale could, however, be used in industrial enterprises to determine the intelligence, and hence the probable efficiency of illiterate or poorly educated aliens seeking employment, and on all others of equal intelligence, such as the negro population of certain parts of the South. One must remember that ignorance is not feeblemindedness, and one of the advantages of the scale here given is its ability to separate the two.

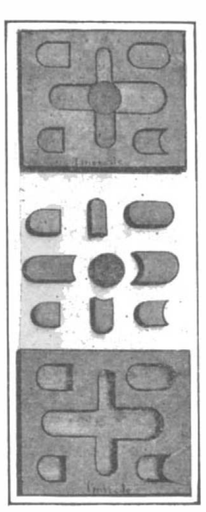
The questions and other requirements of this scale for the various ages were arrived at as the result of experimental and practical work on thousands of aliens of many nationalities and all ages;[1] for instance a large number of 8-year-old children were able to count backward from 20



Two Models of the Casuist Test. Twelve-year-old children find this test easy to perform.




*A* is the Fernald test, *B* the Gwyn triangle, and *C* the Kempf diagonal. All are used in the make-up examination.

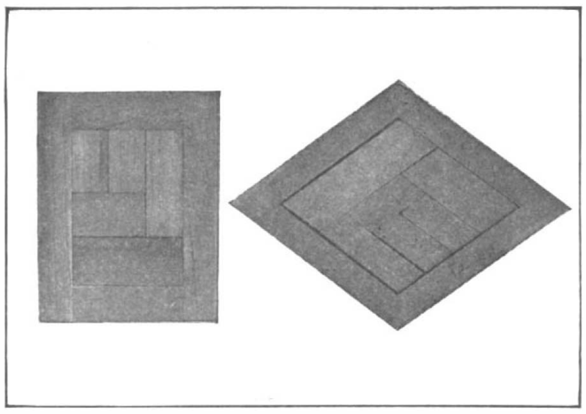


Two Models of the Imbecile Test. Intelligent six-year-old children can put these pieces back with very few mistakes.

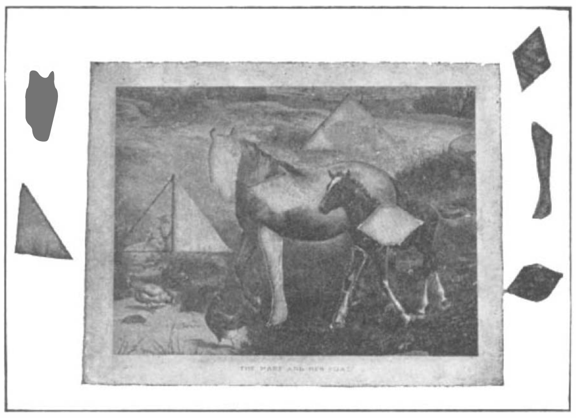
Surgeon L. L. Williams and staff of the United States Public Health Service, at Ellis Island, N. Y. These officers stand guardian to our national health, and the colossal piece of preventive medicine carried on by them saves the country untold millions of dollars each year and helps to maintain the high physical and mental standard of our race. The officers of the United States Public Health Service are commissioned by the President in the same manner as are the officers of the Army and Navy, and the scheme of the Service as regards rank, pay, duties, and social life is in general the same.

Feature Profile Test. The subject is expected to put the seven detachable feature pieces in place in five minutes. The features are engraved on wood.

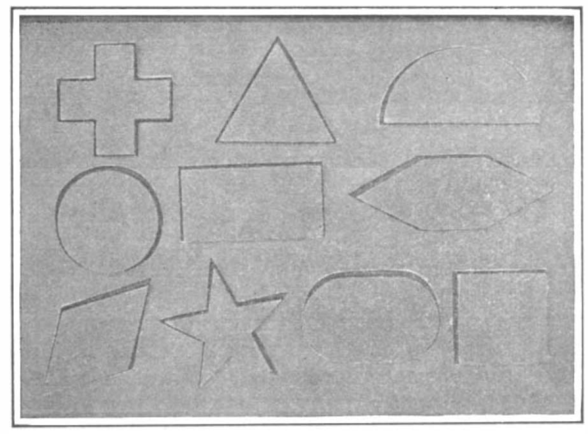
[1] Readers interested in statistical tables of experimental work are referred to page 745 *Journal of the Am. Med. Association,* March 7th, 1914, and the author will furnish reprints of this article to those interested.



The Diamond Frame Test. There are six pieces all cut on the bias, which fill the frame evenly. It is approximately a nine-year-old test. It is a most difficult test for anyone to perform quickly if he is laboring under any emotional stress, and for this reason it serves as a useful indicator of the degree of excitation.



The Horse Picture. This is a picture from a child's picture-book, pasted on a piece of boarding. Average nine-year-old children should be able to put these pieces back in 5 minutes, and adults in a correspondingly less time. Defectives often have difficulty in replacing the two right-angled triangles, even after considerable practice.



Seguin's Formboard. The formboard is shown to the person to be tested with the pieces out and in a pile beside it. He is told that they all fit in evenly and smoothly in such a way as to leave no extra space unfilled. He is told to put them is as rapidly as he can, and the examiner notes the time required with a stop watch.

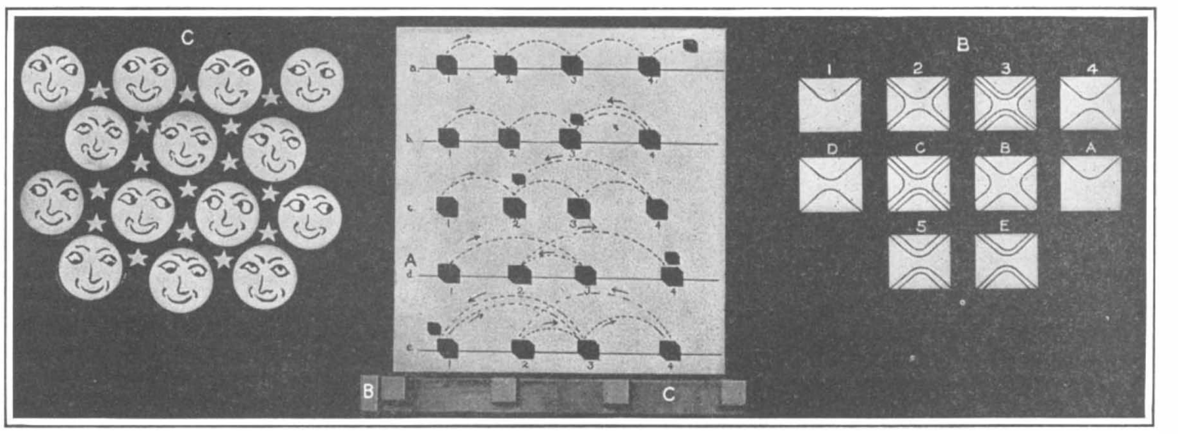
to 1 and a large number were able to repeat five figures after the examiner as 7, 3, 5, 9, 2, and it was, therefore, concluded that these requirements were fair to ask of all 8-year-old children. The majority of the cases examined were somewhat below their racial and social average, so that the only criticism of the measuring scale is that it is too easy, at any rate it is eminently fair to anyone tested by it. The idea of using a graduated scale with performance tests for determining the intelligence of aliens, and especially illiterates, upon whom no real honest work had ever before been done, was original with Surgeon Ezra K. Sprague of the Public Health Service, and to him much honor is due for the present efficient methods at Ellis Island.

It will be seen that certain questions are applicable to every year up to and including 13 years of age, and all persons over 13 years should be able to do the 13-year requirements; in other words, for the purposes of examination 13 years is adult or maximum development so far as the scale is concerned. The "mental" age of a given individual is the point in the scale beyond which he can go no farther; suppose for example that a man of 40 years could only do the things that a 9-year-old should do, we would say that this man was but 9 years old mentally, and this is a very common place for the mentally retarded to stop, in fact, a great many tramps such as the ones that go to make up the "hobo" armies that travel about the country and annoy church gatherings are actually less than this age mentally. They are easily led and influenced.

The personality is an entity apart from a man's intellectual ability so that a fine looking, clean, pleasing, and companionable person may be wofully lacking when one goes beneath the surface. It is necessary then to find out what that special brain is capable of doing, and we do this by "trying it out" on the various details of the measuring scale. All conditions should favor the one undergoing the examination; the room should be quiet and well ventilated, the temperature should be not over 70; there should not be over three persons present, if the subject does not understand English an interpreter should be used that he thoroughly understands; the examiner and the interpreter should be calm, patient, and kind, the subject should be encouraged and never told that he is wrong. He should previously have had a good meal, and if possible a bath and sleep. Allowance must always be made for fear and mental stress under which the subject may be laboring, and two or more separate examinations on different days may be necessary to accurately determine the upper limit of his ability.

It will be noted that wooden tests are an important part of this measuring scale; they are not puzzles in any sense of the word, they are simply performance tests of gradually increasing complexity suitable for the various years of mental development up to adult life, and persons over 13 years of age should have no difficulty with any of them; they require a little native ingenuity, constructive imagination and sense of form and some judgment, but not any more than the least endowed of normal illiterate adults should possess; in fact, all should be able to do with considerable facility everything in the scale, and if any man cannot do this he is to be looked upon with suspicion, and I personally would not want such a person attached to any project that I had an interest in, for he might at some inopportune time blow out the gas or turn the wrong switch.

The term "Educated" to be used further on simply indicates the ability to read and write; to persons educated beyond this the scale is far too easy. No tests for 1- and 2-year-olds will be given. The examiner need not begin at the beginning if the person he is testing is able to begin higher.




The Moon Section of the Visual Comparison Test. This is composed of fourteen moon-like figures which may be drawn with a pen by the examiner if some little care is used. They should be drawn in two rows of three and two rows of four, as in the engraving. The eyes of four of the figures are made to look to the left, and the eyes of each of the others must be made to look in other directions. The subject is started on the upper left-hand moon, and told to point out the four that are looking toward the (subject's) left.

Cube Test. This test has given satisfaction as a weeding out test in sorting out defectives from large bodies of men where time was a factor to be reckoned with. The cubes are usually painted red, blue, green, and yellow, so that they can be used in testing for color intelligence, and for the reason that they make the test somewhat easier than when it is done with plain cubes of one color. The colors make a command test possible also. *C* is the actual cube board used, and *A* is the block used to tap the cubes.

The Envelope Section of the Visual Comparison Test; the designs used here suggest envelopes, and as in the case of the leaves of the Leaf Cluster Section, the objects used here (envelopes) are familiar to everyone. The principles involved in the use of the Leaf and the Envelope Sections are not all the same for the reason that in the latter there are only four true pairs, the other two odd designs, "2" and "B," while they appear on casual examination to be mates, prove on closer inspection to have a different spacing between the interior lines.

### A Scale for Estimating Mental Defects in Illiterates and Others.

A normal child should be able:

*At 3 years to—*

1. Recognize toys and other simple objects.
2. Point to ear, nose, or lips when told to do so.
3. Repeat two figures, as 7, 5, after examiner.
4. Recognize objects in child's picture-books with which it is familiar.
5. Give its full name when asked.

*At 4 years—*

1. Put some pieces in Seguin's formboard. (Above.)
2. Imitate line *a* of cube test. (Center of page.)
3. Repeat three figures as 7, 9, 5.

*(Concluded on page 57.)*

**A mentally defective immigrant woman attempting to perform the fourth, or *d*, line of the cube test, with which she had but little success, having failed in three out of four trials. She was the mother of three children, one of which was defective also, and the other two, while normal intellectually, were, of course, capable of transmitting feeble-mindedness and neuropathic tendencies to their offspring.**

**There is practically nothing in the physiognomy of this immigrant that indicates the gross mental defect that he possesses. The alien is performing, with considerable difficulty, the Seguin formboard, a task which should not require more than 20 seconds in normal adults; this alien required anywhere from 45 seconds to 4½ minutes, and his performances did not improve with practice and repeated trials.**

## Temperature in Plants

By S. Leonard Bastin

THE question of the degree of warmth which is evidenced in living plants is of great interest. Although the matter is one concerning which our knowledge is by no means complete, certain remarkable facts have been established. In the first place the process of respiration is associated with a considerable liberation of heat. This is commonly illustrated in a simple experiment with germinating seeds, such as peas. A thermometer is placed among the seeds which are starting into life. This shows a distinct rise of temperature, usually about 2 deg. Fahr. when compared with a thermometer whose bulb is not among the germinating seeds. The respiration of the seeds involves the taking in of oxygen and the giving out of carbon dioxide, the same process as that of animals. During respiration a greater or less amount of heat is produced.

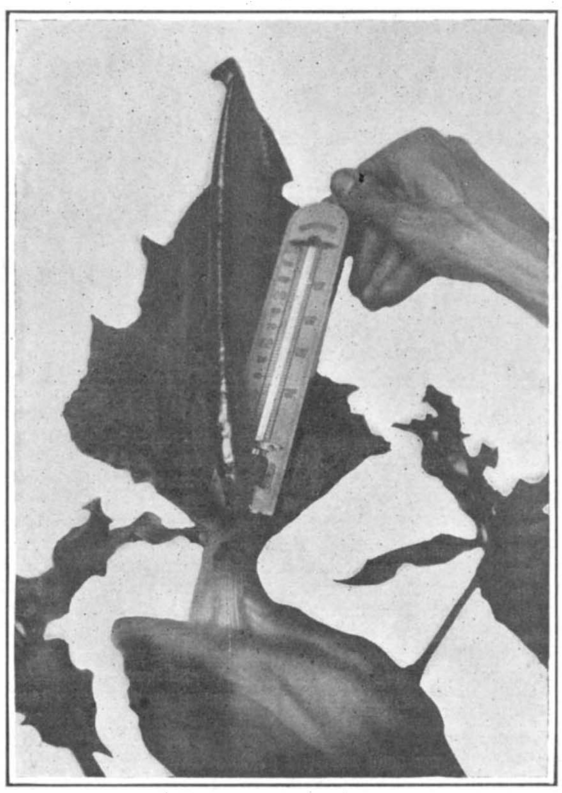
As we ascend in the scale of vegetable life we shall find that the respiration of the seedlings is trifling compared with that of certain plants. At some periods in the development of a plant, and especially in particular parts, extremely high temperatures are produced. The case of the Alpine soldanellas is very remarkable in this direction. It is the habit of these plants to start active growth very early in the spring, long before the crust of frozen snow has disappeared. Yet, owing to the large amount of heat which is liberated by the shooting flower stalks, these are able to bore their way up through the snow just as if they were so many hot wires. It should be borne in mind that the flower stalks are of an exceedingly slender growth, and it is simply owing to the heat they liberate that they can make a way through the snow crust, which is often exceedingly hard. Where the covering of snow is very deep the flowers of the soldanella often do not reach the surface at all. In such a case they expand in a little cavity, which they thaw out in the shape of a dome. Strangely enough, even under these untoward conditions, the blossoms are able to develop their pollen. Certain species of Aroids are remarkable on account of the great heat which they produce in their flowers buds at the time of opening. The case of the Brazilian *Monstera deliciosa* is notable. Experiments have shown that inside the spathe of this plant the temperature was 100 deg. Fahr., while the air outside was 78 degrees. Even more astonishing was the case of the *Arum italicum*, a common species on the Mediterranean coast. Here, when the outside air was registered at 60 degrees, the inside of the spathe showed a temperature of 110 degrees!

Apart from the question of respiration it is known that plants are able to maintain a certain temperature within themselves. Protoplasm is killed by extremes of heat or cold, and it is obvious that some means must be taken to prevent a harmful rise or fall in temperature. Here the facts are not entirely understood, but some very fascinating experiments have been carried out. These seem to show that in a general way the temperature of the plant is a fairly stable feature, whatever the external conditions may be. The ordinary temperature of the blood of human beings remains at about 98 deg. Fahr., whether the individual is living in the tropics or the Arctic regions. It is very much the same with plants. The long spells of hot dry weather experienced in Australia are, of course, notorious; but, however scorching the sun may be, the sap of the plants remains cool. It is a common practice in some parts for the natives to cut open the roots of eucalyptus trees in order to avail themselves of the store of water. The method of procedure is on the following lines. The long side roots are laid bare for a distance of 20 or 30 feet; these are then cut into short lengths, from which the water drips steadily. The soil through which these roots are running may be baking hot, seeing that the roots are often only about 6 inches below the surface, yet the water which drips out is always deliciously cool. It is quite wholesome and free from any unpleasant taste. Melons and gourds of all kinds are astonishing in their powers of keeping cool, even under the most scorching conditions. The cool feeling of the skins of these fruits is not simply an illusionary effect, for, if tested, it is found that the temperature is really much below that of the atmosphere. An accompanying photograph shows a singular experiment in the testing of the temperature of a gourd. The thermometer, in a fairly strong sun, ran up to 110 deg. Fahr., yet the temperature in the interior of the fruit was little more than 60 degrees!

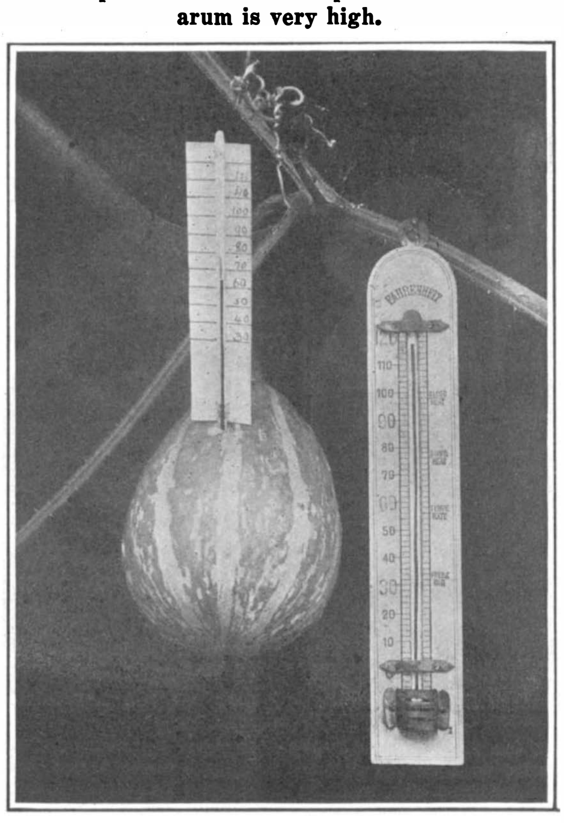
This maintaining of the temperature in the plant is a process which is directly associated with the life of the specimen. The coolness in the gourd only remains so long as it is attached to the plant; when the fruit is cut it rapidly becomes as warm as the atmosphere surrounding it, just like any other object. Of course it is well known that even in an inanimate object a certain coolness may be brought about by evaporation. Thus the water in a porous vessel keeps cool even in a hot sun. This is owing to the fact that the water is constantly passing through the porous sides of the vessel, and being turned into vapor. As a consequence, the air surrounding the vessel is kept in a cool condition. The moisture in plants cannot be kept cool by evaporation or else during spells of dry weather the sap would disappear altogether. As a matter of fact, everything we know about plants which live in hot dry countries shows that all kinds of devices are employed to check and prevent loss of moisture. The loss of water by evaporation through the thick skin of the gourd must be very slight, while the leathery covering of the cacti probably hardly transpires at all.

**The Alpine soldanellas bore through the snow like hot awls.**

**Where the snow crust is too thick the soldanella buds melt out a cavity.**



**The temperature within the spathe of the Italian arum is very high.**



**However hot the sun, the gourd remains cool.**

## Archimedes and His Lever

By C. O. Sandstrom

"GIVE me a fulcrum and a place on which to stand and I will raise the earth from its place!" That is a saying popularly attributed to Archimedes. If the required conditions were possible the feat might be performed, but in addition to providing a fulcrum and a place on which to stand Archimedes would also have to be furnished an indefinite lease of life.

To raise the earth a height of one inch by the force which Archimedes would have been capable of exerting would take not only an extremely long lever, but an extremely long time, as can be readily shown.

We shall assume the following data in our calculation: that the earth is a sphere 7,926 miles in diameter and that 5.5 is its mean density, also that the lever has no weight. Should we design a real lever it would be of such enormous size and weight that Archimedes' weight would be a negligible quantity.

If the earth is 7,926 miles in diameter, the volume is about 261,000,000,000 cubic miles, or 38,400,000,000,000,000,000,000 cubic feet, and if the density is 5.5 the weight per cubic foot would be about 344 pounds, which, multiplied by the volume, would give as the weight of the earth 13,209,600,000,000,000,000,000,000 pounds. We shall assume, further, that Archimedes weighed 150 pounds, and that "the place on which to stand" was some distant star; then, if the fulcrum is one mile from the point of application of the lever to the earth, the length of the power-arm of the lever, or the distance of Archimedes' "standing place," would have to be 88,064,000,000,000,000,000,000 miles. To move the earth a distance of one inch, Archimedes' end of the lever would have to move through a distance of 1,388,000,000,000,000,000 miles. Now, if Archimedes should take hold of the end of the lever and apply his weight of 150 pounds to it, and should move off into space with the velocity of light, or 186,000 miles a second, it would take him 237,000 years to finish the job he proposed, so that now, nearly 2,200 years after making the famous dictum, he would barely have started the undertaking.

Should Archimedes, while flying through space at the above rate of speed, encounter the atmosphere of some planet, the effect would be that of striking a solid, and he, for an instant, would perform the function of a swiftly moving hammer with a very long handle.

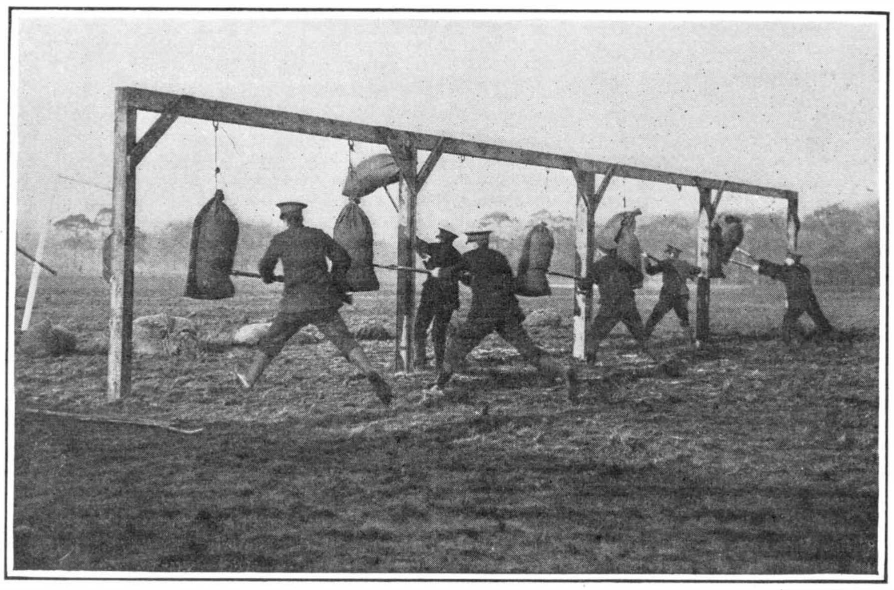
## Dr. Hall, the Aluminium Pioneer

DR. CHARLES MARTIN HALL, the pioneer in and inventor of processes for the production of aluminium, which made the practical, commercial use of this invaluable metal possible, died recently at Daytona, Fla. Dr. Hall was 51 years old, unmarried, and his home was at Niagara Falls, where the great aluminium plant with which he was identified is located.

Dr. Hall was born in Thompson, Ohio, and was educated at Oberlin College. At an early age he became interested in the subject of aluminium, which then was worth twenty-five dollars a pound, and devoted much time to a search for a cheap method of producing the metal from some of the multitude of the sources everywhere at hand; and in this he was successful, for at the age of twenty-two he invented the process based on electrolysis, which, with later improvements, has resulted in reducing the price of aluminium to about eighteen cents. He started to produce aluminium in Kensington, near Pittsburgh, where he was able to turn out fifty pounds a day at two dollars per pound. When the power of Niagara was turned to the production of electricity the possibility of obtaining unlimited current at a low cost led to the removal of the plant to Niagara Falls, where the industry began to grow at an astonishing rate, and the inventor amassed a great fortune, not, however, until after a hard fight in the courts to sustain his claims. Dr. Hall received his doctor's degree from Oberlin in 1910, and in 1911 received the Sir William Henry Perkin Gold Medal. He was a member of a number of the leading scientific and technical societies.

---

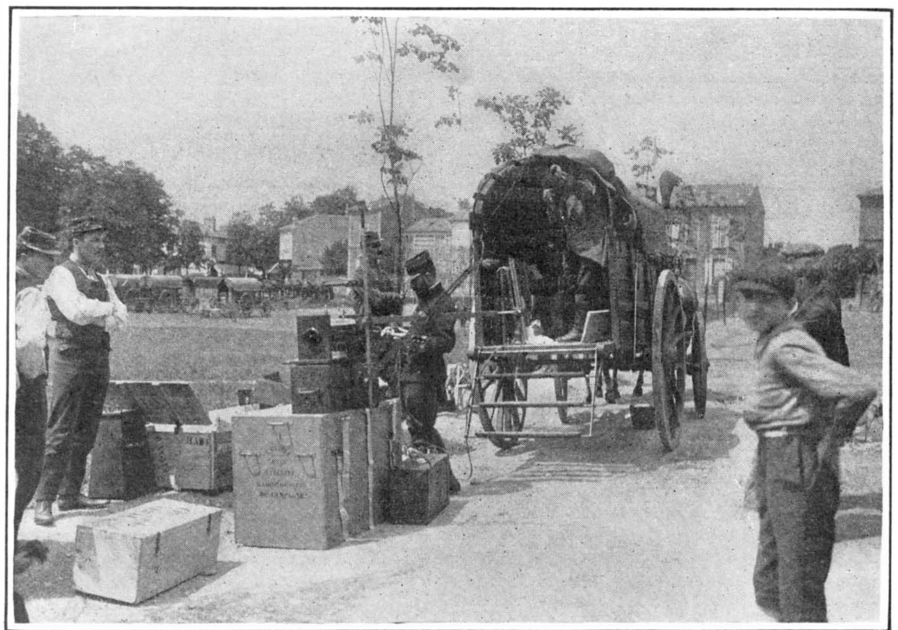
**Farmers' Bulletins**, the most popular and generally useful publications of the Department of Agriculture, were issued during the last fiscal year to the total number of 14,960,000 copies, which is greater by about 50 per cent than the number issued in any previous year. The new publications in this series numbered 55, while 284 earlier issues were reprinted.



British recruits in bayonet practice on dummies.

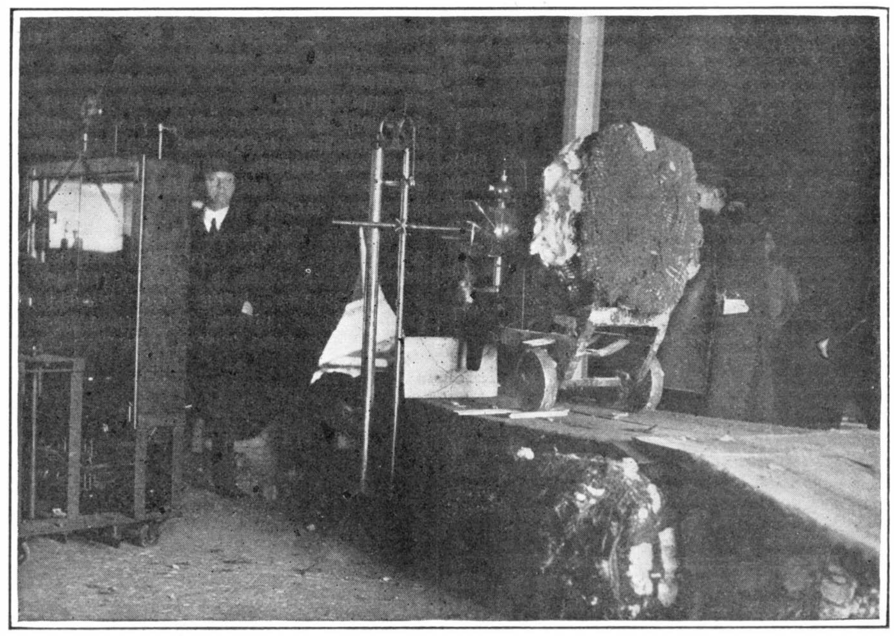
Photographs by Underwood & Underwood.

Kitchener's recruits in cross-country drill.



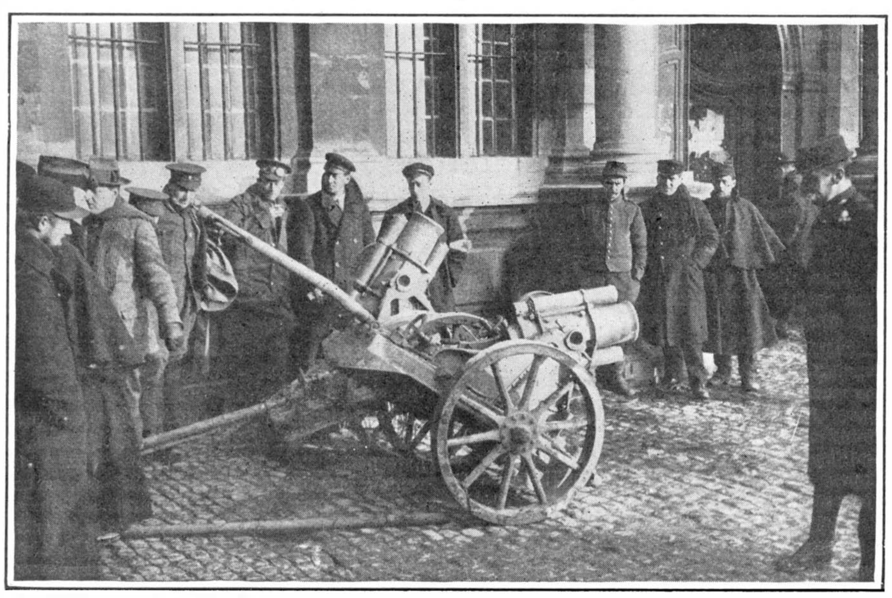
Copyright by International News Service.

An X-ray wagon at a French field hospital.



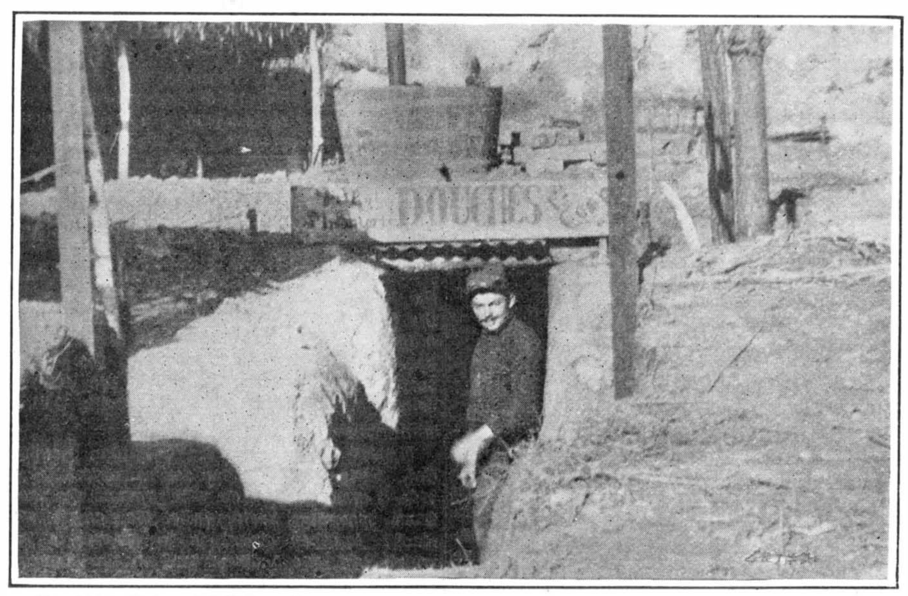
Copyright by American Press Association.

Searching cotton for concealed arms, with X-rays.



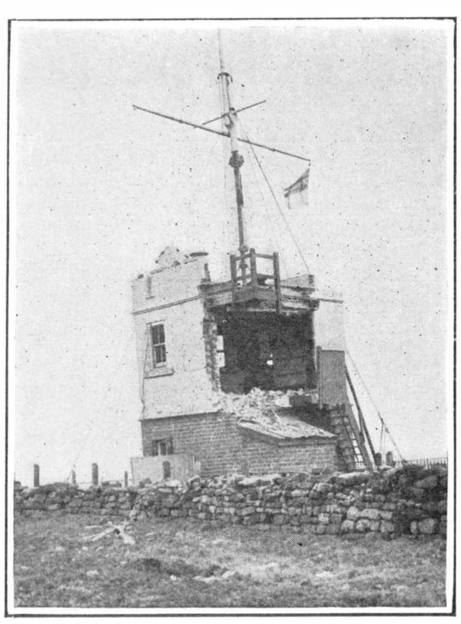
Copyright by International News Service.

German short-range mortars captured in Flanders.



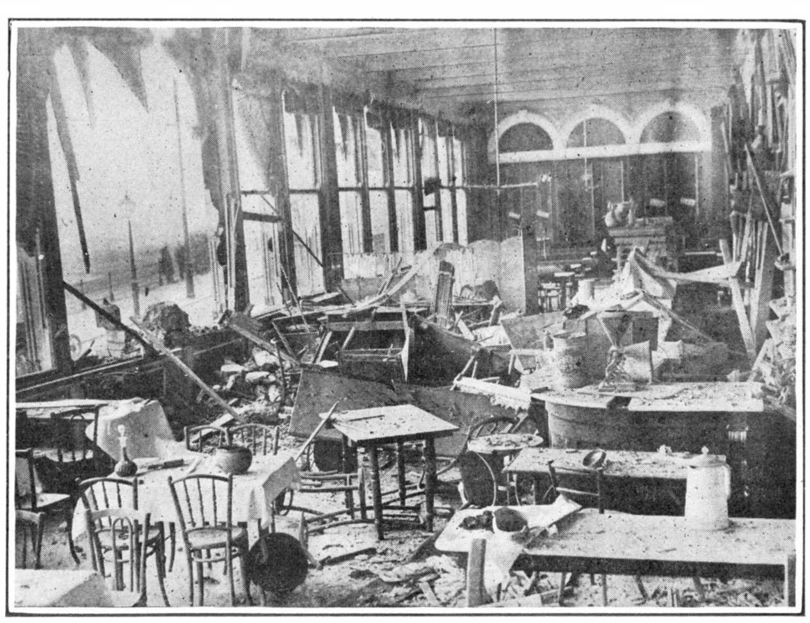

Copyright by Underwood & Underwood.

A bathroom in the French trenches near Soisson.



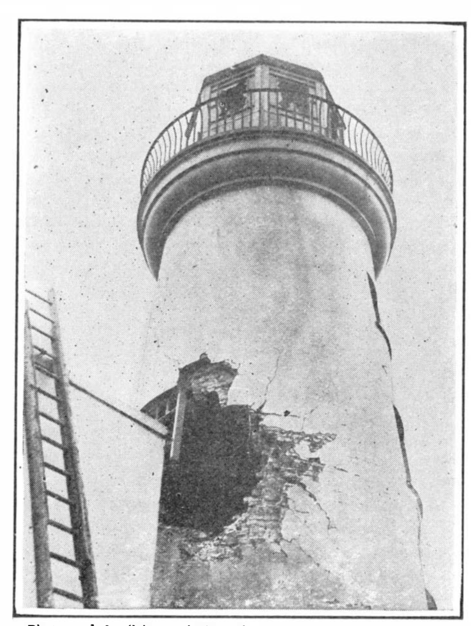
Photograph by Levick.

Whitby coast guard station after the German raid.



Photograph by Sport and General.

Havoc wrought in the Grand Hotel at Scarborough by the German bombardment.



Photograph by Sport and General.

Scarborough lighthouse damaged by a shell.

PICTURES FROM THE FRONT

## RECENTLY PATENTED INVENTIONS

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

### Pertaining to Apparel.

SAFETY POCKET FOR TROUSERS.—C. MILLER, 30 W. Center St., Shenandoah, Pa. This invention has particular reference to the provision of a novel pocket construction adapted especially for men's trousers. It provides hip pockets for trousers, the openings of which are practically invisible, making a garment of neat appearance.

DRAW STRING.—BERTHA CLARK, 228 52nd St., Brooklyn, N. Y., N. Y. In this patent use is made of a draw string adapted to be inserted in the hem of a garment and fastening means attached to the ends of said draw string for fastening the ends together, one of the end members having retaining means adapted to engage one end of the hem to hold this member against slipping into the hem.

KNIT UNDERGARMENT.—J. H. REANEY, care of Union Mills, Inc., 377 Broadway, N. Y., N. Y. The invention relates to knit undergarments, and is more particularly intended for producing union suits. It produces a knit garment having a body of comparatively large size, without employing a large machine such as is necessarily employed to produce a garment of similar size according to present methods.

CORSET LOCK.—J. SCHOENER, 2018 85th St., Bath Beach, Brooklyn, N. Y., N. Y. This invention provides a device whereby a corset can be easily and quickly locked, which device will not accidentally unlock itself, and which will render the corset less cumbersome, as the number of securing means can be greatly reduced, which means, furthermore, when locked will stay in locked position, and when unlocked will remain so.

INSOLE.—O. O. BYRD, 2641 Olive St., St. Louis, Mo. This insole is of a type suitable for wear in shoes, boots, slippers and similar footwear, the purpose of the device being to promote the ease and comfort of the foot, and especially where the foot is afflicted with corns, bunions, callouses or other analogous sources of discomfort.

GARMENT.—AMELIA B. WELLS and MATILDA BLICKHAN. Address the former, 121 W. 88th St., Manhattan, N. Y., N. Y. In the present patent the invention has reference to women's wearing apparel, and the object of the improvement is to provide a new garment which combines an apron, wrapper and street dress, and which can be readily and quickly converted from one to the other.

NEGLIGEE SHIRT.—G. H. NICHOLAS, 854 W. 181st St., New York, N. Y. This invention provides for effective ventilation of the wearer's body by currents of air being created within the shirt as the arms of the wearer are moved, the reinforcing of the shirt being effected by a single strip extending down the body of the shirt at each side from the sleeve to the bottom and covering the upper part of the seam of the sleeve, the seam between the side seam of the latter, with means for the eduction and induction of air by bellows-like action of the shirt as the arms are moved up and down.

### Of Interest to Farmers.

EGG CASE.—G. TIEMAN, care of P. W. MAHLER, Michigan City, Ind. The invention relates to a shipping case for containing breakable commodities, such as eggs, and relates more particularly to a case of that type in which oppositely disposed cellular holders combine to form receptacles in which the eggs are individually placed.

FRUIT SEPARATOR.—G. W. JOHNSON, Box 325, Yuba City, Cal. The invention pertains more particularly to apparatus for separating frozen fruit from good fruit, such as oranges and lemons, and the aim is to provide means whereby to accomplish this result without the necessity of a running stream or current of water.

CRATE.—J. F. CARROLL, Concord, Neb. This crate is for use in shipping farm produce and the like, and the sides and ends can be made out of a single blank of metal, such as sheet steel, so stamped as to provide the necessary openings for ventilation, and at the same time having sufficient strength and rigidity to protect the contents.

### Of General Interest.

OIL SEPARATOR.—W. MCCLINTOCK, 1992 Belmont Ave., Bronx, N. Y., N. Y. In this patent the invention has reference to the separation of liquids and has particular reference to an improved apparatus whereby liquids of different specific gravities may be separated primarily by the operation of gravity.

BOX BRACELET.—J. A. OEXLE, 153 De Mott Ave., Clifton, N. J. This bracelet is one of that type consisting of a plurality of box-like jewel-holding units which are hingedly connected together in such a manner that when the bracelet is closed it will form a rigid annulus that will set on the wrist like a single-piece annular bracelet, and which, when open, can be straightened out like a chain.

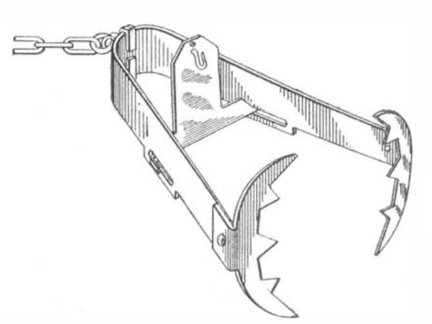
JACKET FOR HOT BOTTLES.—J. J. SCHWARTZ and L. R. STRAUSS, 77 Grand St., New York, N. Y. This invention provides a flexible covering adapted to be detachably secured to the bottle or bag, said jacket serving as a protector from injury to a person using the hot-water bag without diminishing the efficiency or quality of the bag, which jacket, furthermore, prevents a too rapid radiation of heat from the bag and serves, so to say, as an accumulator therefor.

HIGH LEVEL INDICATOR FOR LIQUIDS.—LUTHER K. SELTZER and J. O. STÄHR. Address the former, 144 Elliott Ave., Yonkers, N. Y. The invention consists of an indicator to be applied to the vat to warn the attendant when the beer is approaching the top of the vat, so that with the device in position in the usual vent hole and the filling pipe connected to the vat, the attendant may spend or occupy his time in any other work until the audible signal is given for the cutting off of the flow.

TREATMENT OF SEWAGE AND THE LIKE.—N. TESTRUP, 6 Broad Street Place, London, E.C., England. This invention relates to the treatment of sewage or the like and has for its object to provide an improved process of disposal of such matters allowing of effecting this more cheaply than heretofore, and in some instances without cost. This result is largely obtained by the recovery of valuable constituents of the substances.

STEEL BARGE OR SCOW.—J. P. KARR, 921 Grace St., Fort Wayne, Ind. The inventor has devised and constructed a scow which practical experience has demonstrated to meet all requirements. It is made of plate or sheet steel and in sections which may be easily secured together or detached from each other, as conditions require. The joints between the separable parts are provided with rubber or equivalent gaskets which render it water-tight.

ANIMAL TRAP.—R. P. ESTRADA, Magdalena, Sonora, Mexico. An object here is to provide a device which is of an exceedingly simple construction, being made principally of sheet metal of uniform thickness stamped and bent into the form desired. Another object is to provide a trap including a trigger which may be set at different distances from the jaws and is adapted to be sprung either by pushing or pulling it, according to the nature of the animal to be caught.



ANIMAL TRAP.

OFFICE DESK.—F. BIANCHI Y RECHE, Madrid, Spain. This desk or table possesses two separate work-leaves which are disposed one above the other and united between themselves in such a way, that on drawing forward the lower leaf, the upper one retrocedes, and the invention differs from the known types of tables of this class, because on pulling the lower leaf, this latter occupies the original position of the upper leaf, while the latter, on being pushed toward the back of the table, is simultaneously lifted.

HAME HOOK.—J. T. TAVERNER, Redbank, Cal. This invention has for an object to provide a structure which will prevent the traces from becoming accidentally disengaged when slack. Another object is to provide a hook which will give a direct pull on the hame and which will not become entangled with a corresponding hook or other attachment when the horses crowd together.

PRINTING STAMP.—HENRY SCHMIDT and F. HUBERT. Address the former, care of Fulton Rubber Type Co., 128 Fulton St., Elizabeth, N. J. This inventor provides means for altering the operative or service relation of the dating type and the printing type on the pad; provides means for varying the imprint of the dating type; and provides for simplifying and arranging the elements forming the stamp.

### Hardware and Tools.

NUT LOCK.—S. E. CREASEY, Alfred, Maine. This invention provides means for holding two nuts on a bolt, the one from a rotary movement and the other from a longitudinal movement relative to the bolt; provides means for locking a nut on a bolt, said means being adapted for withdrawal from operative position when engaged by a follower nut; and provides a follower nut and a relatively slidable member to engage a clamping nut to cut the threads thereof so as to prevent the revolution of the nut on its bolt.

### Machines and Mechanical Devices.

WASHING AND CONVEYING MECHANISM FOR MACHINES FOR WASHING AND DRYING SENSITIZED PAPER.—R. B. SNOW, 3064 Bailey Ave., Bronx, N. Y., N. Y. The improvement has special reference to a washing and conveying mechanism for machines employed for washing and drying sensitized paper, and more particularly to a machine which is adapted for effectively washing and drying sensitized paper or prints in long or short lengths and for discharging them on to a platform or table after they are dried.

MANUFACTURE OF PISTON PACKINGS.—F. W. LANCHESTER, 53 Hagley road, Edgbaston, Birmingham, England. This improvement consists in a method of manufacturing spring piston rings, which includes the use of a former of such a non-circular figure, that a ring blank shaped from it, when reduced in circumferential extent by the removal of a portion of the circumference, becomes on compression a circular ring of the required finished size.

REPRODUCING MACHINE.—A. BOCK, 353 Euclid Ave., Cypress Hills, Brooklyn, N. Y., N. Y. The object here is to provide a reproducing or copying machine designed for reproducing statuary, relief plates and other works of art, either of the same size as the pattern or of an increased or a diminished size, and without the aid of a skilled artisan.

CONTROLLABLE ELEVATOR SAFETY STOP.—C. B. ISNER, Minesink Ford, N. Y. This inventor provides inexpensive means which can be controlled by the elevator governor or by means that can be manually operated by the man controlling the movement of the elevator. He also provides a controllable safety stop whereby when falling the elevator is gradually brought to a stop.

BOTTLE CAP PADDING MACHINE.—A. JOHNSON, 14 Dunham Place, Brooklyn, N. Y., N. Y. This invention provides a machine to completely pad prepared caps by a continuous operation; reduces the factor of manual labor attending the operation of padding caps; avoids injury to the adhesive member employed in the operation of padding; and permits vapors or gases generated in the operation to escape.

HINGE WIRING MACHINE.—A. W. GEORGE, 299 7th St., Brooklyn, N. Y., N. Y. This invention refers to improvements in machines for placing wire in boxes for providing a pintle for the hinges thereof, and has for an object to provide an improved structure which will automatically and accurately place the pintles in position.

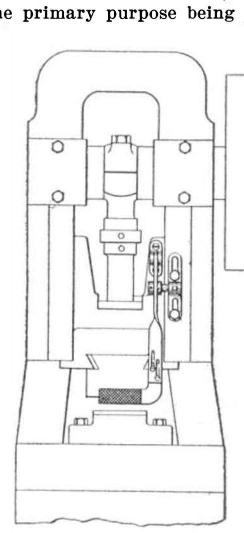
AUTOMATIC MEANS FOR LOWERING LIFE BOATS.—R. TJADER, care of Marine Efficiency Co., 17 Battery Place, New York, N. Y. This invention relates to ships and has particular reference to means for supporting life boats on the decks of ships, and also for the rapid manipulation of the life boats either for hoisting or launching, more particularly the latter.

COAL WASHER AND ORE CONCENTRATOR.—A. C. CAMPBELL, Asheville, N. C. The object here is to provide improvements in coal washers and ore concentrators, whereby a novel percussive action is given to the pan to facilitate the separation of the heavier and lighter materials, and to allow convenient adjustment of the parts to suit the nature of the materials under treatment.

MACHINE FOR APPLYING LEAD HEADS FOR NAILS.—M. F. TUCULET, 671 Calle Maipú, Buenos Aires, Argentina. The invention relates to a machine designed to staple cold lead heads on the ordinary tacks in order to prevent them from rusting and thereby greatly increasing their efficiency for securing in place the tin plates, galvanized iron, etc., from which roofs, and walls of warehouses, and other ordinary buildings are formed.

STEAM SHOVEL.—J. T. ALBERT, Empire, Canal Zone. The invention refers to excavating machinery and has particular reference to heavy steam-operated excavators or shovels. It equips a steam-operated dipper or shovel with auxiliary steam mechanism for tripping the dipper at the dump, such auxiliary steam mechanism being under the direct control of the dipper man on the boom.

SAFETY DEVICE FOR PUNCHES.—N. STUKALO-COYLO, 255 Vine St., Hartford, Conn. This invention relates to power machinery and has particular reference to safety appliances therefor, the primary purpose being to provide an attachment for a machine punch or the like, having a reciprocating part whereby it is practically impossible for the operator to have his hands injured by a movement or impact of the reciprocating part of the machine.



SAFETY DEVICE FOR PUNCHES.

### Railways and Their Accessories.

METAL RAILROAD TIE.—W. C. PARRY, Marble, Col. This invention relates to railway equipment and has particular reference to crossties for railway rails. Among the objects of the invention is to construct a railway tie principally of metal and provided with easily operated and reliable rail clamping devices.

AUTOMATIC TRAIN STOP.—W. S. PIKE, 1004 Corming St., Red Oak, Iowa. In the present patent the invention has reference to automatic train stops; and the object of the improvement is the provision of means for automatically applying the air brakes and closing the throttle valve when the engine of a train leaves the track.

DOOR LOCK.—M. T. HELGESON, Box 34, Buford, N. D. An object here is to provide an inexpensive lock which will draw the door tightly against the door post when the lock is made to engage the post. Another object is to provide a door lock which will not be affected by the vibration produced by the movement of the car.

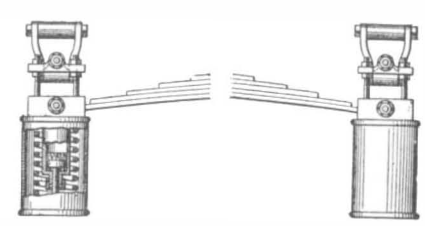
MAIN-ROD BRASS.—F. A. EICHORN, Oakdale, Tenn. This invention produces brasses of the form making unnecessary the use of separate liners usually employed; provides a brass having a steel key-engaging liner embedded therein and essentially integral therewith; provides a form of main-rod brass having an increased amount of bearing metal; provides a strengthening liner that will hold the parts of the brass in position should brass become broken; and provides a form of brasses having strengthening liners so formed and disposed therein as to make the matting brasses reversible and interchangeable.

### Pertaining to Vehicles.

AUTOMOBILE SIGNAL.—G. W. BARRINGER, Box 304, Lawrence, N. Y. The invention relates to improvements in signal devices for automobiles, and has for an object to provide a structure adapted to be operated from the seat of an automobile and when so operated will throw out or move out an arm to one side at the rear of the automobile.

ELEVATING TRUCK.—E. M. CHAPMAN and C. E. COWAN, care of the latter, with The Essex Pad and Paper Co., Holyoke, Mass. The present invention relates to elevating trucks which are utilized to raise and transport various articles of considerable weight which are supported a sufficient distance from the surface on which they stand to enable the placing of the lowered truck therebeneath, for instance, stoves, safes and the like.

SHOCK ABSORBER.—D. M. SHERMAN, 404 E. 51st St., Manhattan, N. Y., N. Y. Use is here made of a support mounted on the free end of the axle spring, a cylinder supported on the free end of the vehicle body spring and partly filled with a liquid, a piston movable on the said cylinder and connected with the said support, and a spring interposed between the said cylinder and the said support.



SHOCK ABSORBER.

COMBINATION SLEIGH AND WHEELED VEHICLE.—W. E. WISE, 421 Rural Ave., Williamsport, Pa. The invention relates to a vehicle provided with running wheels, and with sleigh runners rockably mounted on the vehicle to take positions beneath the wheels, to convert the vehicle into a sleigh, or to a raised position when the vehicle is to be supported on its wheels.

VEHICLE WHEEL.—J. HEIMLICHER, Defiance, Ohio. This invention relates to vehicle wheels and more particularly to metallic wheels. It provides a wheel having a demountable rim. It also provides a metallic rim having comparatively resilient spokes removably associated with the felly and hub.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

## INQUIRY COLUMN

**READ THIS COLUMN CAREFULLY.** You will find inquiries for certain classes of articles numbered in consecutive order. If you manufacture these goods write us at once and we will send you the name and address of the party desiring the information. There is no charge for this service. *In every case it is necessary to give the number of the inquiry.* Where manufacturers do not respond promptly the inquiry *may* be repeated.

MUNN & CO., INC.

*Inquiry No. 9391.* Wanted the name and address of makers of plants for the utilization of by-products from sawdust, also waste wood.

*Inquiry No. 9398.* Wanted the name and address of a manufacturer of a machine to print and label lead pencils and pen-holders.

*Inquiry No. 9400.* Wanted to buy an insoluble, non-fusible and opaque plastic material to be used in die moulds for manufacturing tobacco pipes of special kind.

*Inquiry No. 9401.* Wanted the name and address of the owner of a second hand aeroplane motor from 20 to 30 H.P.

*Inquiry No. 9403.* Wanted the name and address of a glass manufacturer who can blow a small glass article to order.

*Inquiry No. 9406.* Wanted the name and address of a manufacturer who can supply insole material in rolls The material seems to be scrap leather composed and attached to a canvas bottom.

*Inquiry No. 9407.* Wanted the name and address of some patented mechanical device which saves money or time or both, which if properly handled will bring a large demand. It must not be too expensive. It may be electrical as well as mechanical. A first class article desired.

*Inquiry No. 9408.* Wanted the name and address of a manufacturer or distributor of a machine which will clean both single and double burlap bags; especially heavy bags.

*Inquiry No. 9409.* Wanted to secure a patented device which can be manufactured at small cost and around which a good business could be built.

*Inquiry No. 9396.* Wanted the names and addresses of makers of furnaces for reducing carbonate of barium to oxide, electric or otherwise.

*Inquiry No. 9399.* Wanted the name and address of workers in ornamental polished stone.

*Inquiry No. 9404.* Wanted the name and address of a manufacturer of a tool for cutting nicks in plate glass used for name plates and house numbers.

*Inquiry No. 9405.* Wanted the name and address of a manufacturer who is able to supply an attachable eyelet, aluminum or celluloid through which a snap fastener would work.

*Inquiry No. 9410.* Wanted the name and address of manufacturers of "Scuffer Shoes."

*Inquiry No. 9411.* Wanted the name and address Of a gas lighter using some form of platinum black which ignites by holding over a flow of gas.

*Inquiry No. 9412.* Wanted the name and address of a manufacturer that makes machinery for making bichrome ribbons for typewriters.

*Inquiry No. 9413.* Wanted the name and address of a manufacturer of calendar clips for pencils or pens. Miniature pad tears off same as large calendar pads. Celluloid protecting shield.

*Inquiry No. 9414.* Wanted the name and address of a manufacturer who will make an armchair with an adjustable foot rest.

*Inquiry No. 9393.* Wanted the name and address of someone who has an article which could be made in a large Hickory Handle plant.

*Inquiry No. 9394.* Wanted the names and addresses of firms that deal in machinery for manufacture of plaster of Paris and drying by hot air.

*Inquiry No. 9395.* Wanted names and addresses of manufacturers capable of manufacturing cloth Boards (made of paper, wood, and metal) also sample books. One who is able to turn out unlimited quantities at right prices.

*Inquiry No. 9397.* Wanted the name and address of a manufacturer of a machine that will automatically dose and fold powders and other preparations.

## Measuring Human Intelligence

(*Concluded from page 53.*)

4. Recognize ring, pencil, shoe, hat.
5. Know own sex.

*At 5 years—*

1. Put all pieces in Seguin's board in 3 minutes.
2. Imitate line *b* of cube test.
3. Count any number of fingers the examiner holds up.
4. Copy a square and a circle.
5. Obey two commands as, "Shut the door and hand me the pencil."

*At 6 years—*

1. Do imbecile test in 5 minutes with less than six mistakes. (Page 52.)
2. Do line *c* of the cube test.
3. Build structure with four blocks after seeing one like it for twenty-five seconds.
4. Know right or left hand or ear.
5. Know own age.
6. Obey three commands, "Open door, bring book, and shut window."
7. Know purpose of domestic animals that are familiar.

*At 7 years—*

(If educated: In addition, copy a sentence of ten words.)

1. Do geographical or jig-saw test in 5 minutes.
2. Do imbecile test with more facility.
3. Build structure as at 6 years, using five blocks.
4. Copy a diamond with a lead pencil.
5. Repeat four figures as 9, 8, 7, 4.
6. Count readily from 1 to 20.
7. Name the action shown in simple pictures as "driving horses."

*At 8 years—*

(If educated: In addition, write from dictation a sentence of ten words.)

1. Do Healy frame test in five minutes.
2. Do line *d* of the cube test.
3. Count from 20 to 1 without over two errors.
4. Describe the difference between: Water and milk; horse and cow; if familiar.
5. Repeat five figures as 7, 3, 5, 9, 2.
6. Recognize the colors red, blue, green, and yellow.

*At 9 years—*

(If educated: Make a sentence using the words man and dog. Give the opposites of good, right, white, wise, giving an illustration such as "tall, short.")

1. Do diamond frame test in five minutes.
2. Put the sections in horse-picture in 5 minutes.
3. Put the pieces in Seguin's board in 20 seconds.
4. Know the date within three days.
5. Name the days of the week and tell the time.
6. Arrange five cubes, of the same size and color, weighing 9, 12, 15, 18, and 21 grammes in the order of their weights. Should be correct two out of three trials.

*At 10 years—*

(If educated: Make a sentence of not less than ten words, using the words man, dog, and gun. The answer must show some thought and not be simply, "I saw a man, dog and gun the other day." This would be almost a failure.)

1. Do Moron test in 5 minutes.
2. Perform the visual comparison test.
3. Name the months of the year.
4. Additions of like followed by unlike numbers, as: 6 and 6 = ? 6 and 5 = ? 5 and 5 =? 5 and 4 = ? up to and including 8 and 8 = ? 8 and 7 =?
5. Do simple addition of two numbers, one of which is increased each time by 1, as: 7 and 1 = ? 7 and 2 = ? 7 and 3 = ? 7 and 4 = ? 7 and 5 = ? etc., to 7 and 8 = ?
6. Name the days of the week backward.

*At 11 years—*

(If educated: Make a sentence using the words man, dog, gun, and rabbit, showing each of these taking an active part.)

1. Do *e* line of cube test without being shown over five times. (Page 53.)

2. Repeat six figures, as: 6, 9, 2, 5, 7, 3.
3. Of a simple story of five details remember at least three.
4. Tell difference between ice and glass, the feet of horses, cows, and dogs, or other objects chosen from the subject's experience.
5. Give an intelligent account of occupation for the past year.
6. Concrete subtraction of simple numbers from 10, as 10 eggs — 3 eggs = ?

*At 12 years—*

(If educated: Test the person in the spelling of such words as he commonly uses. Then have him give the multiplication tables from 4 to the table of 8, inclusive.)

1. Do Casuist test in 5 minutes with sensible mistakes if any.
2. See absurdities, as: "A man walked down the street swinging a cane with his hands in his pocket." "Man cut into ten pieces, suicide?"
3. Syllogisms, as: "I am taller than my brother and my brother is taller than my father. Which of us is the tallest?"
4. Story solution, as: "A man was walking in the woods and he saw something hanging from a tree that frightened him; he ran back to the village and told the police. What did he see?"
5. Concrete subtraction of simple numbers from 20; as 20 cents less 4 = ?.
6. Divide twenty apples into four equal parcels; how many will be in each?

*At from 13 years onward—*

(If educated: The degree of education must be ascertained and questions improvised that will tend to show how much the man profited by his education and, in short, whether he knows as much as he ought to.)

1. Do Feature Profile test in 10 minutes.
2. The picture of a ship pasted on a board and cut into ten equal-sized pieces of the same shape, should be properly assembled in 10 minutes. The pieces are all cut vertically and parallel to each other.
3. Obey four commands.
4. Problem: "My head is to my hat as my hands are to my ————?" (gloves).
5. Define justice, pity, truth, goodness, and happiness.
6. Combine factors in concrete addition, as: 1 horse and 1 man have how many legs? 1 horse and 1 man and 1 chicken? 2 horses and 1 man and 2 chickens?

*Make-up tests for adults—*

These are to be used on those who, judged by the preceding tests, are subnormal, but not less than 7 years old mentally.

1. Put the four pieces into Gwyn's "triangle" three times in 45 seconds.
2. Put the pieces into Kempf's "diagonal" inside of three minutes.
3. Put the pieces into the Fernald board inside of five minutes.
4. Count 60 dots, each about 1/8 inch in diameter, arranged in ten parallel lines.
5. Give an intelligent and connected account of the technicalities of the previous occupation.
6. Permit the subject to choose a topic about which he says he is familiar and allow him to discourse on it at length. (If this is done well and the subject uses more than fifty words in his description the examiner should be particularly sure of his ground before certifying the case.)
7. The ink-blot imagination test.

The Make Up tests are used a day or two after the first examination has been conducted in order to find out whether the man really did the best he could or whether the poor showing was do to fatigue, fright, or possibly fear or indifference. The tests used at the first examination can be used also, but they are no longer real tests to that particular man because he has already seen and worked with them.

To illustrate the working of this measuring scale of intelligence and to demonstrate how an American business man could weed out the worthless and very often dangerous mental weaklings from his service the writer will cite the case of an immigrant picked at random from the thousands of defectives that have been handled by the United States Public Health Service at Ellis Island. It is to be supposed that this scale should be of particular value in the industries at this time when alien labor is being so widely employed, especially since it was founded scientifically upon work done upon aliens. Investigation has shown that they are frequently the cause of serious and expensive accidents, and the immigrants immediately connected with these accidents have often been grossly lacking mentally. The fact that mental defectives are generally inefficient is well known.

A rather attractive looking illiterate alien, aged 20, was held on suspicion of being mentally defective because he added poorly; a brief examination revealed the fact that the *d* line of the Cube test was difficult for him, and that he made many mistakes in counting from 20 to 1, and could not count from 20 to 1 by 2s at all. He was accordingly detained, and on the following day he was tested by the scale given here with the following result: He did all the 7-year requirements, only one (No. 6) of the 8-year requirements (refer constantly to the scale for the age requirements), No. 5 of the 9-year ones, Nos. 2 and 3 of the 10-year requirements, and No. 6 of the 11-year requirements. Now, since there are six requirements in the year above the one he did successfully, and he did without error five of the requirements of various years above the 7-year tests, he was rated by us as 7 5/6 years mentally by the scale, and in reality he was flattered by this rating. To give him every possible chance he was examined again on the following day, at which time he only did creditably one of the requirements that he had before failed on, and that was No. 3, counting from 20 to 1, of the 8-year one. Of the Make Up tests he accomplished No. 1 fairly well; this performance gave him the final rating of 8 1/6 years mentally. He was certified by us as "feebleminded" and promptly deported by the Immigration Department. This man would have been one of the first to obey a walking delegate or to commit an outrage planned by someone else. We are safe then from this special alien who otherwise would have been one of us.

## War Experiences of an Air Scout

(*Concluded from page 51.*)

stated that, through my inability to speak the French language, I would be of little or no service to the French government. He communicated by telegraph with the Minister of War, who, a week later, on November 2nd, took action and wired Capt. Duperron my honorable discharge.

I left for England at once *via* Boulogne, to Folkestone and London, where I visited the War Office of the English government and made application for appointment with the Royal Flying Corps.

Under date of November 16th I received the following communication from the War Office:

"With reference to your letter of the 7th instant, I am directed to inform you with regret that there is no vacancy in the Royal Flying Corps, in which your services could be utilized."

Upon receipt of the above I decided to return to America, and booked passage on the steamship "Lusitania," which arrived at New York on November 27th.

### The French Aeroplane Corps.

In my nine-week stay in France I have noticed many things. In the United States we imagine that the French possess the largest and best flying corps in the world. I have discovered it to be in a poor condition. They possess about one half the machines that are claimed for them. Pilots like Vedrines are begging for machines; but Vedrines, being but an ordinary soldier like myself, is shown no favors, and those officers who have perhaps one tenth the experience of Vedrines come first and get the best machines,

while Vedrines receives a poor one; hence his presence at the camp at Tours awaiting a machine.

When the order was issued abolishing the further use of all Blériot, Nieuport, Deperdussin, and Rep monoplanes and only permitting the use of the Caudron, Voissan, Henry, and Maurice Farman biplanes and the Morane-Saulner monoplane, there were thirty escadrilles of Blériot monoplanes at the front (one hundred and eighty machines and pilots, there being six machines to an escadrille) and another thirty escadrilles of the three other types of monoplanes. Thus there were nearly four hundred machines thrown out, together with two hundred more of the same types that were held in reserve.

The Morane-Saulner monoplane of the two-place type has an automatic gun attached, and this machine, owing to its speed and fast climbing abilities, is used to bring down machines of the enemy.

The Caudron biplane is used for the same purpose and for locating the artillery of the enemy, in order to give the range to the French and English gunners. This machine is one of the lightest in weight in France, is very small, and is able to climb at the rate of 5,000 feet in fifteen minutes.

The Voissan biplane is used exclusively for the carrying and dropping of bombs on the enemy, this machine being able to carry considerable weight.

The Farman biplanes will be used for observation purposes, they being capable of flying for many hours at a time.

Machines are being continually smashed up, chiefly through carelessness. The mechanics work as they please. Some days the pilots at Tours were unable to fly, as there mechanics were obliged to serve guard duty for one day each week, and there is a rule that the mechanics who work on one type of machine must not work on any other type.

At Tours, once a week, the pilots must take turns as guards. I could not speak any French, nevertheless I served one day as guard in three tours of two hours each and six-hour intervals at a fixed point, to halt would be passers-by or any wandering Germans who might happen along.

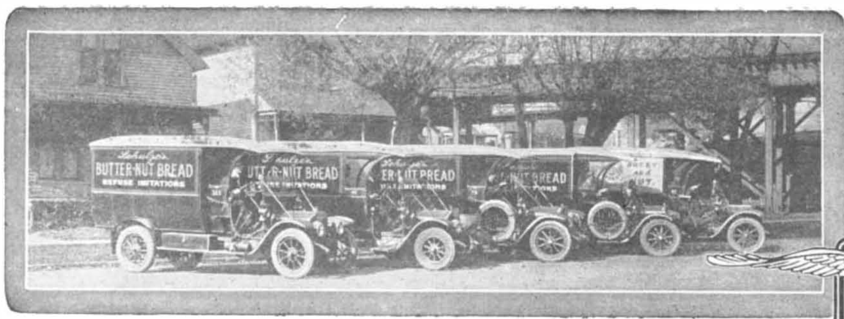
I received a single 50 centime piece for my first ten days' work. One cent a day! I have pierced a hole in the coin and keep it as a souvenir. After I obtained my military brevet I was paid 21 cents a day. My expenses were exactly 40 cents a day, so it can be readily seen that anyone volunteering his services to France must have some pocket money, especially if he is used to good eating.

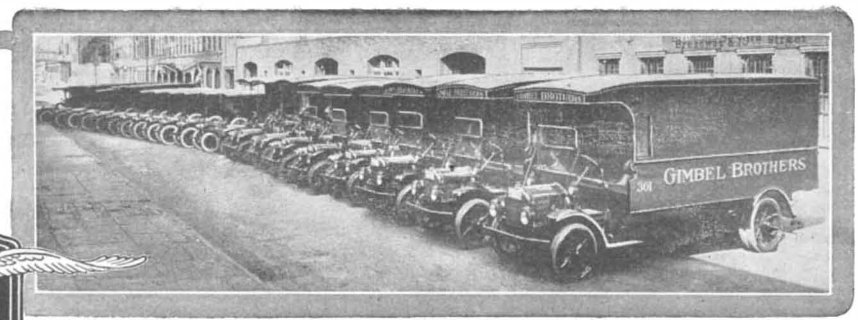
### New Railway Signal

A MERE piece of red glass has made it possible to use red light on railroad-crossing gates, and add greatly to the safety of motorists and other drivers at grade crossings. This has never been possible before for fear of confusing engineers on passing trains, but a simple device worked out in the signal department of the Lehigh Valley Railroad has made feasible the adopting of red lights at every grade crossing in the country. It has been tried out at the busy Wyandotte Street crossing in Bethlehem and has proved a success. The ordinary crossing gate has a white light hung to the bar, which at night indicates by its position alone whether the track is clear. But by this device a piece of red glass set in a roundel, as in a frame, is fastened to the bar so that the white light swings behind it and shows red when the gate is down. When the gate is up, as the roundel is stationary and the light swings, the light comes out from behind the red glass and shows white again. At no time is the red light visible from the track, and traffic on the railroad is not interfered with, but the safety of motorists and the drivers of other vehicles is increased.

---

**The Population of Manila** increased from 234,409 in 1912 to 266,943 at the beginning of 1914. Male inhabitants were more numerous than female by about 32,000.




Truck service is measured primarily by the quality built into the product......and by pre-purchase counsel that enables the buyer to get a truck fitted to his requirements. Such service is good for the buyer and for The White Company, because the interests of buyer and seller are mutual both before and after the sale.

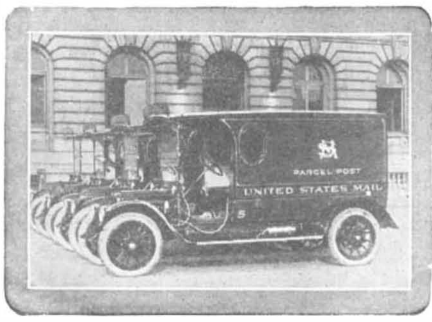
Service in a White is haulage......ton-miles. This puts profit in the buyer's till. Service that means *only* quick repairs is like a crutch or a splint. Service that is *built in* means maximum hauling and minimum dry-docking.

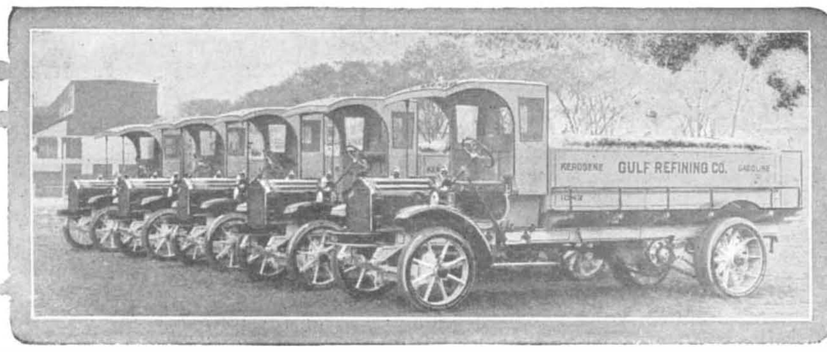
White Trucks are the trucks most generally selected by those houses whose trucking problems call for fleets. Fleets grow gradually. They indicate to the thoughtful business man......that the first truck or the first few trucks gave eminent satisfaction......and the fleet grew.

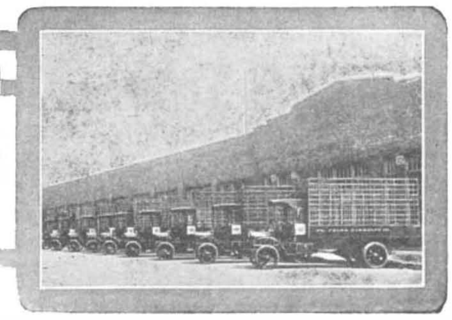
Drivers in a White fleet can go readily and without experiment from one truck to the other. The care and adjustment are uniform. To know one White is to know all. White trucks are made in every capacity...... three-quarter ton up to five tons.

THE WHITE COMPANY

CLEVELAND





# SCIENTIFIC AMERICAN


DIVER LEAVING A SUBMARINE TO PLANT A MINE.—[See page 68.]

Vol. CXII. No. 3
January 16, 1915

Munn & Co., Inc., Publishers
New York, N. Y.

Price 10 Cents
$3.00 A Year

# SCIENTIFIC AMERICAN

**Founded 1845**

**NEW YORK, SATURDAY, JANUARY 16, 1915**

**Published by** Munn & Co., Incorporated. Charles Allen Munn, President; Frederick Converse Beach, Secretary
Orson D. Munn, Treasurer
all at 361 Broadway, New York

Entered at the Post Office of New York, N. Y., as Second Class Matter
Entered as Second Class Matter at the Post Office Department, Canada.
Trade Mark Registered in the United States Patent Office





**Subscription Rates**

| | |
|---|---|
| Subscription one year | $3.00 |
| Postage prepaid in United States and possessions. Mexico, Cuba, and Panama | |
| Subscriptions for Foreign Countries, one year, postage prepaid, | 4.50 |
| Subscriptions for Canada, one year, postage prepaid | 3.75 |

**The Scientific American Publications**

| | | |
|---|---|---|
| Scientific American (established 1845) | per year. | $3.00 |
| Scientific American Supplement established 1876. | " " | 5.00 |
| American Homes and Gardens | " " | 3.00 |

The combined subscription rates and rates to foreign countries including Canada, will be furnished upon application
Remit by postal or express money order, bank draft or check

**Munn & Co., Inc., 361 Broadway, New York**

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.


*The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.*

## Unjust Criticism

We can boast of some fine achievements in the field of transportation in the United States, and among these the most remarkable, at least from the standpoint of safety, is the enormous number of passengers which have been carried year in and year out on the subway system of New York without any fatalities or even serious accidents. There is nothing in the whole world to compare with the record for safe travel over this underground system; as witness the fact that during the last nine years of its existence the subway carried over 2,000,000,000 passengers with the loss of but a single life—in fact, the first fatality in this time was the loss of one passenger in the recent short-circuit trouble to which so much attention has been given in the public press.

We have no wish to minimize the seriousness of the recent situation, when the burning out of the cables filled the subway with acrid smoke and subjected several hundred passengers to the danger of asphyxiation. It is undoubtedly true that it was largely owing to a conjunction of favorable circumstances that there was not a considerable loss of life. At the same time we feel that common justice calls for a protest against the unlimited criticism to which the operating company has been subjected because of this accident; and particularly we would protest against the endeavor which has been manifest in some quarters, to make political capital out of such an every-day occurrence as the short-circuiting of an electric cable—something which in the present state of the electrical art seems to be unavoidable.

Even in such a highly developed art as that of electrical transportation, evidently there yet remain certain lessons to be learned, certain improvements to be made. The obvious lesson of this accident is that the manholes in which the splices of the main cables are located should be absolutely walled off from the subway, so that, in the event of a short circuit, the resulting heat and smoke may escape to the outside atmosphere through gratings or other means at the street level.

The most that can be said, it seems to us, is that the construction used was an error of judgment; certainly, in view of the marvelous record for safe travel which the subway company has achieved, it is grossly unfair to make the charges of criminal carelessness and indifference which have been so freely bandied about in the public press and uttered by public officials. That no less than eight separate investigations into the matter should have been set on foot is ridiculous. The question of this accident and its proper remedy is purely a technical one; and the proper judges in this matter are the experts of the Public Service Commission and of the company which operates the subway.

The Scientific American holds no brief for the Interborough Company; in fact, during the earlier years of the operation of the subway, we were not sparing in criticism of certain features which we believed were faulty and called for drastic remedy. At the same time we cannot but feel that, in the matter of this recent accident, the press and much of the public seems to have lost entirely their sense of proportion. The fact has been entirely overlooked that the one fatality which occurred took place after nine years of the fastest, the most congested and the safest transportation of vast bodies of people, under conditions which reflect the highest credit upon the skill and caution and vigilance of the operating company.

Having recognized these indisputable facts, let every means be taken to prevent any possible repetition of a similar disaster. It is desirable, where long stretches of subway occur on which there are no speedy exits to the street and no means of ridding the subway quickly of harmful gases, to provide, as early as possible, both means of ventilation and means of escape. Additional facilities should be provided to enable the trainmen, in the event of fire or other accident, to communicate at once by telephone with the fire and police departments and with the proper officials of the company. Incidentally, the accident has drawn attention to the advisability of the Fire Department's being equipped with an adequate supply of smoke helmets for use not merely in such contingencies as a fire in the subway, but in fires of any character which may occur throughout the city.

## Industrial Capitals as Factors in War

When war was declared between Germany and France in 1870 the Parisians surged through the boulevards shouting "On to Berlin!" and in Berlin doubtless the cry was "On to Paris!" To-day, except from the pen of the newspaper writer, hard pressed for matter, no such talk is heard; for the day has passed when possession of an enemy's political capital was the decisive factor of the war. Probably, in spite of the rush of Von Kluck's army almost to the gates of Paris, the objective of the German army in the western theater of war was, first and last, the mobile field armies of the Allies. Once these were rolled up, captured, or dispersed and disorganized, the remainder of the German task in the subjugation of France would have been comparatively easy.

Similarly, in the eastern theater of war it is the breaking up, decimating, and surrounding and capturing of the Russian field army that is the objective of Von Hindenburg and his staff. Not only would the taking of Warsaw fail to end the war, but it would have only a temporary effect upon its fortunes. Nor would the capture of Moscow bring Russia to terms any more to-day than in the days of the great Napoleon.

The primary objective of the Allies, both of the French-British armies in France and Belgium and of the Russian hosts in Poland, is of course to achieve the annihilation of the German armies; but the conditions of modern warfare, with its admirable system of intelligence by aeroplane and spies and the wonderful mobility conferred by motor traction, has probably shut out from the councils of the general staff of the allied armies any expectations of the general capture or dispersion of the wonderfully efficient German army.

What, then, is the Allies' objective? If it is not Berlin, the political capital, at what particular point or points are Joffre, Kitchener, and Nicholas aiming with a view to bringing about a decisive conclusion?

To answer that question we must bear in mind how greatly the conditions have changed in Germany since the war of 1870. At that time Germany was an agricultural country which was witnessing the beginning of that industrial development which, in the succeeding forty years, has been the wonder and admiration of the whole world. In the interval the centers of resources and industry, particularly as related to a machine-made war, have been shifted, and they are to be found at opposite ends of the German Empire, namely, in the huge aggregations of mineral wealth and countless manufactories which are gathered in Essen and in the neighboring cities, and also in the rich mining district of Silesia. Should Silesia be overrun by Russia and should the allied French and British forces drive their way through into Rhenish Westphalia and take possession the war would be over. It would be over for the reason that the great sources of supply of the munitions of war and the means of transportation would be closed for the German army; and not all the acknowledged bravery and endurance of the German soldiers would avail if the great arsenals for the output of artillery and ammunition and the vast coal fields for the supply of fuel to the troop trains, to say nothing of the steel works from which come the steel parts for renewals of the military automobile service, were in the hands of the enemy.

So far, then, as the operations on land are concerned, the objective points of the Allies are Breslau and Silesia for Russia and Westphalia for the Franco-British armies. So varied have been the fortunes of war in Poland that it is impossible to make any prediction as to the course of events out there. In France and Belgium it looks as though a turning point had been reached, at which the German offensive was about to be transformed into a powerful defensive. To reach Essen the Allies must fight their way across an average distance of 250 miles of most strongly entrenched and, as is certain to be the case, most bravely and bitterly defended country. Judging from the fighting qualities of the German troops and the exceedingly fine work of their war staff, it is not likely that the Allies, even in the event of a successful offensive, can obtain control of Westphalia before two and one half years of fiercely contested fighting have passed by.

## A Plea for Scientific Methods

Science is perhaps the most inhuman of all man's works. It would seem that man has given birth to a monster vaster than himself, which reaches upward into icy altitudes where he cannot live and stretches down to the unshakable granite of a certitude which lies deeper than all his hopes and desires. Perhaps there is something sinister about this monster. It has shattered man's simple pride and shattered his comfortable faith. And what are its compensations? For more than two thousand years have men groped after scientific knowledge, have spent laborious lives, ay, and suffered martyrdom, in the service of this most detached of all man's offspring. As a result we have achieved modern civilization, that haphazard conglomeration of flaming virtues and bestial vices, of a few men with power surpassing that of Cæsar, with knowledge surpassing that of the old-time gods, and of millions who toil ceaselessly and hopelessly, driven by fear, with their priceless potentialities scotched from birth; the faintest adumbrations of what they might have been. And on the continent of Europe the very nations who have reached the topmost pinnacle of this scientific civilization are slaying one another in hosts greater than any known before in the history of the world.

Knowledge has not saved us; we are no better than our fathers. The old fierce instincts still rule, but nevertheless, if man is ever to achieve salvation, science must play the greater part. The very nature of man is a contradiction. Together with his recently acquired and comparatively weak desires for tolerance, charity and universal fellowship, are those barbaric old impulses, the legacy of innumerable brutal ages, which, after smoldering through many peaceful years, have now flamed out in mad destruction over more than half the world.

The brute in man took a long time in the making; these turbulent emotions have come down to us from very far ages; a few generations of noble thinking affect these old passions very little. We must have faith and patience. In the presence of this upheaval we are too prone to think that science has done nothing that really matters, nothing beyond adding to man's material comforts, building up a heartless civilization, and giving man greater powers of destruction than he ever wielded before. But, indeed, science has done more than that. Scientific knowledge is perhaps of little worth where the great things of life are concerned. Insensate hatred and bloody wars are evidently not avoided by learning that the earth is round, that air is a mixture of nitrogen and oxygen, or even that the universe may have four dimensions. But although the promulgation of scientific knowledge does not greatly alter a man, there is more hope in the promulgation of scientific *method*. A man who habitually thinks on the scientific method learns a fairness and restraint which is one of the most promising things in the later development of mankind. The hysterical outbursts of some scientific men over this war indicate merely that they keep water-tight compartments in their minds and that they fail to practise the scientific method consistently. The scientific method is very simple; it consists in believing no more than the facts warrant and in divesting one's self of national prejudice.

Whatever our sympathies may be, we often get a very hopeless feeling after reading some European writers. It is then that we realize the advantages of the scientific method. It might not be so free and picturesque as their own methods of thought, but it would at least prevent their writing so many pages of addled nonsense. How on earth can a man regard the whole German nation as made up of devils incarnate? It is exactly this fiercely partisan, hopelessly false, and unutterably idiotic frame of mind which made the war possible. A permanent world-peace will never be possible until these screeching "patriots" of all nations are either eliminated or else reduced to an entirely insignificant minority. This means that a very large part of mankind has to undergo a spiritual change; and the supreme value of science lies in this, that it is a living, irrefragable testimony to the efficacy of scientific method, and the steady promulgation of scientific methods of thought among mankind is the best means of effecting this spiritual change. We are hardly at the dawn of things. Science has achieved nothing compared with what the future holds for it. We have learnt a few items of information, it is true—but that is not science. All the treatises on all the 'ologies are merely by-products. Science is a method of thought, and its importance lies in this: a method of thought means a method of life.

## Science

**Red Oxide of Mercury is now being incorporated in** marine paints for coating ships' bottoms. The poisonous nature of the mercuric oxide prevents the growth of sea plants and other organisms which foul the ship bottom and cause the vessel to lose speed.

**The Association of Official Agricultural Chemists** has decided to establish a quarterly journal, which will contain the proceedings of the association's annual conventions. From 1885 to 1912 these proceedings were published annually by the government as bulletins of the U. S. Bureau of Chemistry, but this plan has been discontinued.

**National Bird Reserves.**—According to the last annual report of the General Land Office, the national bird reserves now number 67. Three of these were created during the last fiscal year; viz., Anaho Island, in Pyramid Lake, Nevada, the home of the white pelican; Smith Island, in the Strait of Juan de Fuca, Washington, the roost of wild ducks and geese and many migratory shore birds which have been decimated by pot-hunters; and Blackbeard Island, off the coast of Georgia.

**Motion Pictures in the Department of Agriculture.**—The U. S. Department of Agriculture now maintains its own motion-picture laboratory for producing educational films on agricultural subjects. Several of these have been exhibited to farmers and other audiences by the agents of the department in connection with lectures. This laboratory has also co-operated with the Panama-Pacific Exposition Board in taking and developing subjects for other branches of the government, including the Bureau of Education, the Treasury Department, and the Smithsonian Institution.

**Revegetating Kodiak Island.**—The eruption of Mount Katmai, Alaska, in June, 1912, covered the agricultural and grazing lands in the neighboring island of Kodiak with a heavy blanket of volcanic ash. Experiments in revegetating this land, carried on by the agricultural experiment station at Kodiak, have made such progress that the government herds of Galloway cattle have been returned to the reservations in the island. It has been found that wherever nitrogen is added to the volcanic ash or where the lower rich soil is mixed with the ash excellent crops can be raised. A special plow for mixing the ash and soil has been devised at the Kodiak station.

**Wound Makes a Man See Green.**—A very interesting case is reported of a soldier, in a recent engagement, being shot in the forehead, the bullet passing out of the back of his head without killing or even stunning him. He remarked "Everything seems green all round me," and when in the hospital tent he still persisted that he saw everything green. This case appears to favor the cerebral theory of color vision of Dr. Edridge-Green, the shock to the brain having altered the discriminatory apparatus so that impulses caused by green rays had a preponderating influence.

**Research Fellowships.**—To extend and strengthen the field of its graduate work in engineering, the University of Illinois has since 1907 maintained ten Research Fellowships in the Engineering Experiment Station. These fellowships, for each of which there is an annual stipend of $500.00, are open to graduates of approved American and foreign universities and technical schools. Appointments to these fellowships are made and must be accepted for two consecutive collegiate years, at the expiration of which period, if all requirements have been met, the Master's degree will be granted. Not more than half of the time of the Research Fellows is required in connection with the work of the department to which they are assigned, the remainder of the time being available for graduate study. Nominations to fellowships, accompanied by assignments to special departments of the Engineering Experiment Station, are made from applications received by the Director of the Station each year not later than the first day of February. Additional information may be obtained by addressing the Director, Engineering Experiment Station, University of Illinois, Urbana, Illinois.

**A Manual of Weather Forecasting,** to which a number of officials of the U. S. Weather Bureau will contribute the results of their experience in this kind of work, is now in preparation, according to the last annual report of the Weather Bureau. This is undoubtedly a greatly needed work, since much of the technique of weather prediction, as practiced by meteorological services, has never been reduced to writing, and has perhaps not been fully formulated even in the minds of the forecasters themselves. A preliminary contribution to this subject which the Weather Bureau has just published is a voluminous series of charts with descriptive text, by Messrs. Bowie and Weightman, entitled "Types of Storms of the United States and Their Average Movements." The Bureau is also gradually putting in tangible form the knowledge gained by its officials in the forecasting of floods and river stages. Rules for the preparation of flood forecasts for the Mississippi at St. Louis and for the Susquehanna at Williamsport and Harrisburg, Pa., have recently been formulated and put into practical use.

## Automobile

**Motor Street Sweeper Saves Money.**—The city of Houston, Tex., reports that the use of motor vehicles in sweeping and flushing its streets has resulted in a saving of $1,600 per month. The work formerly was accomplished by means of 20 mules.

**65,000 Motor Trucks in America.**—According to the latest figures obtainable there are at present 65,000 commercial motor vehicles in use in the United States, representing a cash investment of about $16,000,000. The two largest users are the American Express Company with 750 cars, and the Adams Express Company with 650 machines.

**Spring Wheels en Masse.**—An average of 35 patents on spring wheels for motor cars and trucks have been granted per month, since early last year. Not in several years has the crop of inventions along this line been as numerous as at present. About one out of twenty gets a real test, and less than one out of a hundred survives the trial stage. There are at present ten spring wheel designs in commercial use, four of them being often seen in New York city. The rest are born, reared and die with unfailing regularity.

**A Self-adjusting Piston Ring.**—Packing the pistons in an internal combustion engine is not an easy matter, and many are the plans made to circumvent the necessity of continually adjusting and packing loose pistons. A novel type of piston ring has been invented by a Boston manufacturer, in which the use of radial holes serves to equalize the pressure between the outer and inner surfaces. The piston rings have a slightly conical shape, which causes them to be forced tightly against the cylinder walls during the compression stroke, when the tendency of "downward crowding" is at its highest.

**Muffling Exhaust by Turbine Wheel.**—A new form of muffler for the exhaust gases of automobile and aeroplane engines has just been brought out by a Rochester firm. It consists of a small turbine wheel which is revolved rapidly by the impinging exhaust gas, breaking its force and converting the explosive noise into a slight hissing sound. Part of the gases are caught by a baffle plate, but the back pressure caused by this is so small as to be almost negligible. There is no loss in power from the motor, and the inertia of the revolving wheel assists in drawing the exhaust gas from the pipe and manifold, even after the force of the piston movement has passed. The device takes a smaller space than the ordinary baffle plate muffler.

**12,000,000 Tires a Year.**—The average man has but a vague idea of the enormous extent of the automobile tire industry in the United States. There are at present in round numbers 1,600,000 automobiles in the country, and not one of them can possibly get along with less than 4 tires a year. As most of them use much more than that, the most conservative estimate must place the number per car at 6 tires a year. This would be 9,600,000 tires. In addition there are scheduled for manufacture during 1915 not less than 600,000 new cars, which must be fitted with at least 2,400,000 new tires, making a total of 12,000,000 tires, at the very lowest possible figuring. In reality the number is much greater, even though a million or more tires are "re-treaded," fitted with "covers," etc. Taxicabs and some of the high-powered converted racing cars could not possibly get along with less than 20 tires a year. The money spent for tires in 1914 in the United States alone probably exceeded $200,000,000.

**"Zoline" Fails to Make Good.**—For some time past the press of this country has been deluged with sensational reports about a new and wonderful fuel for internal combustion motors that surpassed gasoline in efficiency and could be produced so cheaply that the price of motor fuels would be cut to near the vanishing point. The statement is now given out that because of its apparent lack of practical commercial possibilities Zoline, which was the subject of the Indianapolis experiments, has been dropped by the group of men who were interested in its exploitation. It is stated that among the difficulties encountered was that the naphthaline component, which gave it that moth ball smell, crystallized out in the feed pipes, thus choking the flow of fuel.

**Co-operation in Road Building Matters.**—One of the results of the Road Congress held at Atlanta was the action taken for the formation of the Association of State Highway Commissioners and Engineers. This is an association of the practical men who build the highways, and as it is recognized that the question of good roads is not in any way local, but one whose interests overlap from State to State, the conferences of such men may be expected to be productive of much mutual benefit. Preliminary steps for the formation of such an organization were taken, to be perfected at a future date. At the annual meeting of the American Highway Association, held at Atlanta, Fairfax Harrison was elected president, Logan Waller Page vice-president and Lee McClung treasurer. A number of directors were also selected.

## Astronomy

**Astronomical Telegrams.**—The European war put an end, for the time being, to the work of distributing telegraphic news of astronomical discoveries, heretofore carried on by the Zentralstelle für astronomische Telegramme at Kiel, Germany. It is now announced that this work has been assumed by the University Observatory at Copenhagen, under the direction of Prof. Elis Strömgren.

**Another Astronomical Bull.**—The last number of *L'Astronomie* furnishes a piquant addition to the long catalogue of astronomical "bulls" which that journal has recently been collecting. It appears that one of a series of paintings representing the life of Mahomet, exhibited at the last Salon, and entitled "The Tomb of the Khalifs," shows an evening sky in which the crescent moon, correctly oriented, has a brilliant star *between* her two horns. The idea was borrowed from the Turkish flag, which, however, does not always show the star in this impossible location.

**Proper Motion of Nebulæ.**—Dr. Heber D. Curtis, of the Lick Observatory, has recently given a preliminary account of the results obtained from comparing a large series of nebular photographs made with the Crossley reflector twelve to sixteen years ago, with a similar series now being made with the same telescope. In this interval changes due to motions of translation or rotation in the nebulæ are quite inappreciable, or, at most, exceedingly small. This applies to several large irregular nebulæ, including the Orion nebula, and to several prominent spirals, including the great nebula in Andromeda. It is inferred from these observations that the nebulæ in question are enormously remote, and therefore, of course, enormous in size.

**Variable Brightness of a Comet.**—Interesting fluctuations in the luminosity of comet Kritzinger (1914 *a*) were observed by M. Chofardet at the observatory of Besançon. Although after May 10th, 1914, the comet was receding from the earth, its brightness was estimated as of magnitude 10.5 on May 22nd, and of magnitude 9 on June 10th, while the head had increased in angular diameter from 30 or 40 seconds to 2 minutes. On June 20th the brightness appeared to have again diminished, but hazy weather made this observation uncertain. The above observations were confirmed by those made at Uccle by M. van Biesbroeck, who, after noting the normal diminution of the comet's brightness with increasing distance up to May 15th, was surprised to find a marked increase on June 3rd, when he estimated the magnitude as 8.5.

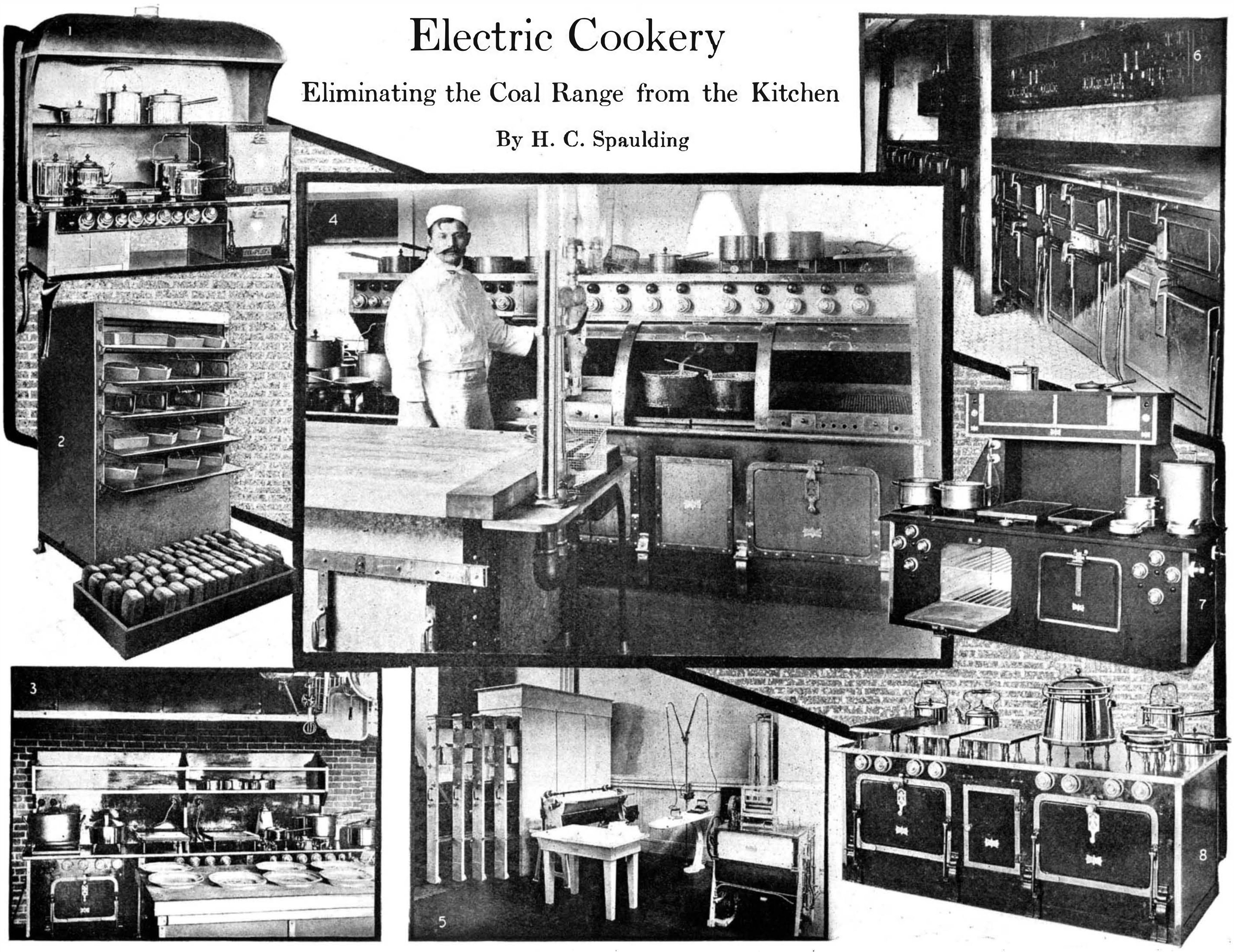
**Stereoscopic Photographs of Comets** have yielded interesting results at the hands of Prof. E. E. Barnard, who has applied this method to the study of Comet Morehouse, of 1908. Series of photographs of the comet made on the same date in various parts of Europe and at the Yerkes Observatory were available for stereoscopic combination, and from the resulting series of stereographs, extending over a period of several hours, it is possible to interpret certain curious changes in the appearance of the comet's tail. At one time the tail was abandoned and drifted away into space, where it formed an irregular ring, from which a secondary tail, in cylindrical form, was developed. Soon after, the nucleus sent out a new tail which appeared to connect with the old one, but which the stereographs show to have really passed behind the latter at a considerable angle.

**Radio Time Service.**—The last annual report of the U. S. Naval Observatory records the increasing importance of the radio time signal which the observatory sends out twice daily, at noon and 10 P. M., *via* the naval radio station at Arlington, and which is thus distributed broadcast over the continent east of the Rocky Mountains and over most of the North Atlantic Ocean. A case is mentioned in which a merchant vessel sailing from New York checked its chronometers daily by this signal until within 600 miles north of Rio Janeiro, or 4,250 miles from Arlington. The noon signal is also sent by radio from New Orleans and both signals from Key West, while in the case of breakdown at Arlington the stations at Newport, New York, Norfolk, and Charleston are directed to send the noon signals. In case of an appreciable error in the signal it is corrected by sending it again one hour later. The mean daily error in transmission during the last fiscal year was 0.055 second, and the maximum error 0.36 second, due to a change of rate in the standard sidereal clock resulting from recent overhauling. The number of small radio sets for receiving the time signals in use throughout the country by watchmakers, jewelers, colleges, etc., is increasing rapidly. A point requiring investigation is the lag, or difference of time, between the transmission of the signal and its arrival at a distant point. This may sometimes amount to 0.3 second. In view of the increasing use of the signals for astronomical and other purposes requiring high precision, the installation of more up-to-date sending apparatus is desirable, and a system of return signals should be arranged in order to ascertain the exact time of receipt of the signals. The observatory wants a special appropriation from Congress.

# Electric Cookery

## Eliminating the Coal Range from the Kitchen

By H. C. Spaulding



**Substituting electric for coal heat in private and public institutions.**

1. Electric range in a private residence. 2. Baker's electric oven. 3. Range in a school at Middlebury, Conn. 4. Kitchen of the Engineers' Club, Boston. 5. An electrically equipped laundry. 6. Galley of the United States dreadnought, "Texas." 7. Range in a Colorado hotel. 8. Electric range in House of the Good Shepherd, Boston.

EVEN in these days when electric toasters, percolators, broilers, etc., for table use are an old story, comparatively few people realize to what an extent and on how large a scale electricity is being adopted for cooking purposes, not only in small or moderate-sized households, in which the safety, convenience, and uniformity of electrical methods would offset a possible increase in cost over coal or gas, but in public and private institutions where the cooking must be done in large quantities, and at first thought the use of coal or gas (with live steam when available) would seem to make for final economy.

Apparently the science of electric cookery is to-day (speaking from an economic standpoint) just about where electric street railway operation was some twenty-five or thirty years ago; a recognized possibility, of which those familiar with results already obtained were most sanguine for the future, but of which the public at large was skeptical, and inclined to consider in the light of an interesting experiment for which the manufacturer—not they—must foot the bills.

Fortunately, for the public welfare, the development of electric cookery methods has in the very nature of things been more gradual and based on more carefully and broadly obtained data than was the case in electric railroading, and at the present time its assured place in household and civic economies seems to be mainly a question of publicity and of the minor improvements inevitable in the evolution of any line of apparatus intended for general public use.

An interesting fact to be noted in this connection is that we in the United States are far behind our friends across the water in this particular line of progress and that "over here" our Western States are, as a rule, far ahead of the Eastern in their readiness to "do it electrically."

Of course the widely varying rates for current are to a great extent responsible for this, although this variance is far from being accounted for in many locations, where, as was the case in the early periods of railroad and telephone development, it seems to be the policy of certain interests to follow public demand instead of to anticipate it, or even meet it half way. When we realize that the cost of electric current in some parts of this country is about four times what it is in others for electric lighting and approximately eight times for cooking, it is not to be wondered why this difference exists and whether it is due to geographical or (local) financial conditions, especially as in some parts of England the rate for current used for cooking purposes is only about one-fifth of the minimum rate here in America.

The explanation obviously involves so many considerations that it is beyond the scope of this article, but briefly, the difference in cost to the consumer is mainly due to (*a*) geographical and (*b*) governmental causes.

In certain localities the development of large water powers has made possible hydroelectric installations which are furnishing electric current at rates which would be impossible where fuel must be freighted, stored and used under ever-varying conditions.

By "governmental" causes we mean primarily taxation methods, which vary in a degree almost unbelievable by those who have not made a special study of the subject. In one instance, that of a central station in one of our largest cities, the total amount of taxes paid is almost exactly equivalent to the net cost of current generated and delivered at the station bus bars!—and this is under a "normal" (?) administration.

The average consumer does not stop to consider that the price charged him for current represents (*a*) actual cost of generation, interest on plant investment, taxes and insurance, (*b*) distribution, including leakage (engineering and financial), superintendence, etc., and (*c*) administration cost, including executive, engineering, legal expense, etc. However, it would seem, in spite of the possibilities for future development, that electrical cooking methods have become an accomplished fact so far as the average household is concerned, since recent investigations on the part of a non-prejudiced authority showed that *more homes in the United States use electric current than are provided with running water*, and wherever electric current is installed electric cooking is a logical and inevitable result.

In public institutions, most of which have their own "isolated" plants, economic considerations are of still greater importance. The current required for cooking purposes is almost entirely an "off-peak" load, and when properly combined with lighting, refrigeration and general power service shows an evident economy over distinct functional operation.

One peculiar feature of electric cooking, aside from safety (no matches, no leaky pipes, no open but unlit valve cocks) is that in cooking meats, fish, fowl, etc., whether baked or broiled, the actual loss in weight or "shrinkage" is much less than when the cooking is done by coal, charcoal, or gas.

As a result not only is there a saving in "bulk," but the food is much more palatable, since the natural juices and flavors of the meat are retained instead of going up the chimney or ventilating flue in the form of vapor, representing a definite economic loss.

That electric cooking on a large scale is no longer an experiment but on an economical as well as practical basis is evidenced by the decision on the part of the engineers of one of the big western trunk lines to use electrical equipment throughout in the kitchens of a new $350,000 station, no coal whatever being used in the building except for general heating purposes.

Now as to cost: A favorite unit basis with writers on this subject (and their name is legion) for computing cooking expense is the "kilowatt-hour at ten cents per." Without attempting to explain what a "kilowatt-hour" is, suffice it to say that your bill for current is based on the number of them used, just as the gas company charges so many "cubic feet" of gas, as shown by the gas meter, at a certain rate.

No one ever saw a cubic foot of gas and no one ever saw a kilowatt-hour of electric current, but the bills and checks representing them are an every-day story.

Very good. The price of these commodities varies all over this big country of ours, for reasons outside the scope of this article, but any reader can find out for himself or herself just what the charge would be per kw.-hour (note the simple abbreviation) and figure out the cost to himself or herself of various operations, from the following data based on a *ten-cent rate*, which is actually in force in many of our large cities and

(*Concluded on page 74.*)

# Where the Smoke Helmet Would be Invaluable

## A Lesson from the New York Subway Fire

THE disaster in the New York subway tunnel, where many hundreds of helpless people escaped death by suffocation from smoke and noxious fumes entirely by good luck, conveys a warning to the whole country in regard to one feature of public safety for which but little provision has been made. Of course subways are not numerous, but what occurred in New York is but an exaggeration of what might happen in many other localities on a smaller scale, and wherever human life is concerned it is well to take thought for its preservation in advance.

In the New York disaster hundreds of passengers in the trains that were caught in the tunnel were rendered unconscious by the smoke and fumes of the burning insulation of the feed cables that carried electricity for supplying power and light to the trains and stations, and their rescue from their dangerous position was slow and rendered difficult because the atmospheric conditions in the tunnel prevented the firemen from reaching these helpless people promptly, and many of the firemen themselves were overcome and required the aid of the pulmotor, which undoubtedly saved many lives. That the casualties were so small was entirely due to the fact that the accident occurred at a point where the subway tunnel was very close to the surface, where a number of openings to the upper air were available; but had it happened at some of the deeper points, probably not one of the fifteen hundred or more passengers in the trains stalled near the point of the accident would have survived.

The lesson of the disaster points most forcibly to the necessity for some device that would enable rescuers, whether firemen or others, safely to penetrate dense smoke and efficiently to carry on the work of rescue. Such devices, generally known as smoke helmets, are by no means unknown, and are in common use by the fire departments of many foreign cities, as well as by a few cities in this country; but in the present case it is the astonishing fact that not a single smoke helmet was available, although the New York fire department is supposed to be one of the best equipped in the world. Why such a condition should be permitted to exist it is impossible to ascertain, but it is known that this department has in a casual way considered the subject of some device that will permit its men safely to penetrate thick smoke in confined situations, but nothing definite has developed.

That the New York fire department should take such an apathetic attitude in this matter is the more surprising, as the reports of almost every big fire in the city contain mention of firemen being overcome by smoke while engaged in the performance of their duties, and in some cases we read of firemen being laid out in rows on the sidewalk, where remedial treatment was applied. As long as this indifference to human safety was confined to members of the paid department the public has assumed that such things were unavoidable, or at any rate all a part of the day's work of a fireman; but since the dramatic incident in the subway people are realizing that it is a subject that is of vital interest to them, and undoubtedly movements will result that will compel the New York fire department to properly equip itself for the saving of life as well as saving property.

As originally organized, all fire departments were intended to be protectors of property only, but the frequent presence of human beings in burning buildings compelled the firemen to extend the scope of their duties and activities; and although the title of such a city department has never been changed, the saving of life has come to be such a recognized function that the firemen are now always called upon as a rescue corps in every case of disaster. Under the circumstances it would be logical to plainly recognize the modern position of the organization and call it the Department of Public Safety, equipping it accordingly.

**Breathing device for use in coal mines.**

**Type of helmets used in German fire departments.**

Devices that enable men to enter places filled with dense smoke and noxious gases and remain for considerable periods of time have been known for many years, and although they undoubtedly have not reached their ultimate development, there is no question but that there are several on the market that are entirely practical. Indeed, many private commercial establishments, such as chemical works and refrigerating plants, make regular use of this means of enabling their workmen to safely conduct operations where dangerous acid fumes exist. In refrigerating plants pipes containing liquid ammonia under great pressure sometimes give way, and except for the use of a protective helmet which enables a workman to enter the unbreathable atmosphere and either repair the damage or close the necessary valves, the establishment might be shut down for an indefinite period and the entire neighborhood endangered.

Passing over the very numerous instances abroad where these life-sustaining devices have been in successful practical use for years, we have a splendid example of what can be done in this direction in this country in the mine rescue work organized by the U. S. Bureau of Mines. When an explosion occurs in a coal mine there is always dense smoke, great quantities of noxious gases, with heavy clouds of stifling dust, conditions practically as bad as existed in the subway fire; but by the use of protecting helmets and apparatus carried on the shoulders of the rescuer, which supplies fresh air, it is possible for a man to enter the most unwholesome passages and save lives that only a short time ago would have been surely lost long before the shafts and tunnels could be cleared of the foul gases and fresh air substituted by the ordinary means. This is not a theory, nor an experiment, for the Bureau of Mines has established a large number of rescue stations at which these helmets are the principal piece of apparatus, and some thousands of miners have been taught to use them; and this organization is constantly saving lives, and has a long record of rescues that meets any argument against the value or the practicability of the device. This record also plainly demonstrates that apparatus of this kind can be successfully used by men of ordinary intelligence and under unusual and trying conditions. These smoke helmets, of which there are quite a variety, usually take somewhat the form of a diver's helmet, although they are of very light construction, as it is only necessary that they keep out smoke and gases. In some cases, where the atmosphere to be encountered is not injurious to the eyes, only a small cone covering the mouth and nose is used, but for general use some sort of a hood that fits closely around the shoulders and is provided with a window and connections for receiving and discharging air is the favored form.

For providing the wearer with air there are several systems employed. The simplest, which is quite extensively employed by fire departments, and which serves its purpose quite well under simple conditions, consists of a light close fitting hood, with a sight window, and having a large tube of airproof cloth that extends down close to the floor, where it gets a supply of moderately fresh air, for in a fire it is well known that the heated

(*Concluded on page 75.*)

**Fireman's smoke helmet, front view.**


**Helmet men belonging to one of the Rescue Stations established by the U. S. Bureau of Mines entering a gallery after an explosion.**

**Smoke helmet, showing intake near floor.**

# Disastrous Burnout in a Subway Manhole

## Lessons that Are Taught by the Accident

A SERIOUS short circuit occurred in the power cables of the New York subway during the morning rush hour on January 6th, which set fire to the insulating materials surrounding the cables, liberating large volumes of smoke and gases that asphyxiated hundreds of passengers in trains stalled in the immediate vicinity. That only one death resulted was due to good fortune rather than any special provision for such an occurrence. It was the most serious accident that has ever occurred in the subway system of New York and it has focused public attention upon a defect that has existed ever since the line was built.

### Power System of the Subway.

The power for the subway system is generated in a large plant at Fifty-ninth Street and Eleventh Avenue. From here alternating current is transmitted to substations, at a tension of 11,000 volts, through cables carrying from 3,000 to 5,000 kilowatts (4,000 to 6,700 horse-power) each; at the substations the power is converted into direct current and transformed to a tension of 630 volts. From each substation low-tension cables carry the current to the subway, where it is delivered to the third rail at stated intervals. Unfortunately, the subway system has no independent right of way for its transmission lines, except for the short cross-town lines running from its various substations and from the main power station. Hence, the subway itself is used to carry the power lines. They are placed in conduits behind the subway walls.

The main high-tension cables come to the subway at Fifty-eighth Street and Broadway and thence run north and south. At various points, where they run out of the subway line to the respective substations, manholes or "splicing chambers" are provided, and here low-tension cables from the substations enter and turn north and south to feed the power rails. Cables are also carried across the subway to splicing chambers on the opposite side. Not only are splicing chambers provided at the junction with conduits leading to the substations, but also at intermediate points, because it is impracticable to make and handle the heavy cables in lengths of more than 500 feet. The splicing chambers may be entered from the subway through a doorway normally closed by a steel door lined with asbestos, and in most cases they can be entered through a manhole from the street as well.

### Cable Insulation.

In electric power transmission we have the curious anomaly that we must depend upon highly inflammable material to prevent fire. The matter has been studied for years, but so far no insulation has been developed that is fireproof and yet waterproof and flexible. Feed cables cannot be introduced into conduits unless they are flexible. The usual high-tension cable construction consists of a multiplicity of copper wires imbedded in a mass of paper or rubber insulation, the paper being treated with some compound to exclude air and moisture. Over all is a lead sheathing to protect the insulation from injury and from climatic conditions.

No matter how carefully the cables have been constructed this insulation is liable to give out at some time. There may be a slight injury to the lead sheathing which would admit moisture. There might be a slight imperfection in the insulating body during the process of manufacture. Deterioration is very apt to set in, and some day when the insulating qualities are sufficiently weakened or an excessive current passes through the cable there will be a complete breakdown—the current will jump from the core of wires inside to the sheathing outside.

Every month the cables of the New York subway are tested by subjecting them to a current three times as great as they are normally adapted to carry, so that if there be a weak spot anywhere it will be discovered. Every effort is exerted to make the splices, electrically, much stronger than any of the rest of the line, but it is at such points that breakdowns are most apt to occur. The main enemy of insulation is moisture, and for this reason there are ventilating gratings in the doors opening from the subway into the splicing chambers.

### Nature of the Short Circuit.

It was in the splicing chamber on the west side of Broadway at Fifty-third Street, where the cable lines connect with the Fifty-third Street substation, that the accident occurred. Just what was the cause of the short circuit no one knows and no one ever will know. Short circuits may occur several times in a month and again not once in a year, but in each case the evidence is entirely consumed and one is left to guess at the probable cause for the breakdown.

In the opinion of the subway engineers, it was probably one of the low tension cables that first gave way, because the arc produced by direct current is apt to be more sustained. When this cable gave way, whichever one it was, it melted out adjacent cables. These in turn were short-circuited and set fire to the rest of the cables successively. The system being thus electrically unbalanced apparently threw an excessive load into the cables on the opposite side of the subway and they also were short-circuited. It was all a matter of a few minutes, but the insulation continued to burn and send off large volumes of smoke and gas which passed into the subway proper.

### Automatic Circuit Breakers.

There is an automatic provision for cutting off the power in a cable system whenever there is an excessive flow of current. A relay circuit is acted upon inductively to energize an electromagnet. The armature of this magnet closes another circuit which operates a circuit breaker in the substation or power plant, thus automatically throwing off the power.

The object of these automatic circuit breakers is not so much to prevent a short circuit, for this they could not do in the majority of cases, but to protect the apparatus at the substations. An enormous amount of current passes through the cables and in case of short circuit an arc could be maintained, which would do a great deal of damage without drawing enough current through the cables to operate the circuit breaker.

In each splicing chamber there is also an apparatus which may be operated by hand to throw off the power. Whether the power was cut off automatically or by hand is not clear at the present writing, but after a number of the cables had been short-circuited all the power of the entire subway system was cut off and the subway was plunged in darkness.

### Subway Lighting System.

Although the subway is lighted by a separate transmission system from that of the third rail, the cables coming directly from the power plant and not from the substations, yet in this emergency, the lighting cables, being adjacent to the power cables, also gave way.

The cars themselves are provided with emergency lamps supplied from batteries, floating on the line, so that they are normally kept charged with sufficient current to keep the lights burning for three hours. They are arranged to light the lamps automatically when the other lamps are extinguished, but for some reason, as yet not clearly determined, some of these lighting systems failed.

### Fire Escapes and Emergency Exits.

To provide ventilation for the subway there are blower fans at intervals situated in ventilating chambers. These also ceased operation as soon as the power was cut down. That there was not an appalling death list is attributable to the ventilation chamber at Fifty-fifth Street, whence there was an exit to the street by way of a ladder. Fire escapes of this sort are provided between all stations from City Hall to Columbus Circle except between the Grand Central and Thirty-third Street stations.

### Conclusions.

As a result of all these conditions the following conclusions may be reached, although they are subject to modification when the investigations which are now being conducted have been pursued to their end:

First: There must be no communication between the splicing chambers and the subway proper. Of course the question of properly ventilating the chambers is involved. Many of them are not wide enough to be simply walled off from the subway, but would have to be enlarged or entirely reconstructed. In some places, for instance, the subway is far underground and a shaft 60 feet deep would be required to provide access to the splicing chambers. The mere provision of a door between the splicing chamber and the subway, even though there were no ventilation opening in it, would be inadequate, because the explosive effect of a burnout would burst them open.

Second: The subject of lighting. Panics cannot be averted without ample lighting. It has been hinted by the Public Service Commission that it might be advisable to light the subway from an entirely separate transmission line, possibly from the street lighting circuits, thus keeping the lighting cables far removed from the power cables and running them into the subway at frequent intervals, so that, in case of a failure at one point, at most only a small section of the subway would be darkened.

Third: The provision of fire escapes. In no public buildings, where such large numbers of people assemble as are to be found in a single subway train, are there such inadequate emergency exits. There should be fire escapes at more frequent intervals and these should consist of broad stairways rather than mere iron ladders wide enough for one person to ascend at a time. In the new subways that are being planned the ventilating chambers situated between stations will be provided with stairways four feet wide to serve as emergency exits. In the case of the East River tubes there should at least be cross passages from one tube to the other.

Fourth: Ventilation. If it is necessary to provide a separate lighting system, it is equally necessary to provide separate circuits for the ventilating fans, for with the ventilation (which is not of the best at any time) cut off, the danger of asphyxiation is very great in a system where practically all the inflammable material is of a type to give off dense, choking fumes.

Fifth: Fireproof cars. We hesitate to think what horrible results might have attended the stalling of a wooden car within the reach of the blowout. We understand that the promise to eliminate all wooden subway cars very soon has already been given.

Sixth: Communication with stalled trains: It would not be a difficult matter to install a telephone system which could be tapped at any point by the conductor of a train, enabling him to get into touch with a dispatcher and obtain immediate and direct instructions in an emergency. Too much reliance is now placed in the individual judgment of the conductors and guards.

## The Sun "Drawing Water"

WHEN beams are seen radiating from the sun, especially when they are directed toward the horizon, the sun is said to be "drawing water," and this phenomenon is popularly regarded as a sign of rain. Probably most children, and perhaps a few grown-ups, have fancied when looking at this pretty spectacle that the lines of light and shadow converging toward the sun were actually streams of vapor which the luminary was sucking up from the earth and which would presently condense into clouds and showers. These lines are, however, the result of the passage of sunlight between clouds already formed. The dark lines are cloud-shadows; the bright lines, sunbeams made visible by the presence of dust or drops of water in the air—like the sunbeams seen in a dusty room. The beams and shadows are really parallel, their apparent convergence or divergence being the effect of perspective. As a rule, the hazy condition of the air that renders the beams visible indicates an active condensation of moisture, and therefore has some value as a prognostic of rain, though, like other local signs, it often fails.

A phenomenon of similar origin is often seen when the sun is below the horizon. In this case a fan-like sheaf of beams is seen spreading upward; lines of blue alternating with the pink of the western sky at sunset, or the eastern sky at sunrise. The morning phenomenon gave rise to the classical description of the "rosy-fingered dawn." The technical name of these fan-like beams is "crepuscular rays." A rarer phenomenon is that of "anticrepuscular rays," which appear to converge toward a point on the horizon opposite the sun. Crepuscular rays are sometimes called "diverging beams," and anticrepuscular rays "converging beams," though the expressions "diverging" and "converging" are necessarily relative terms.

One of the most picturesque legends connected with the solar beams is that told in the islands of the South Pacific, where the beams are known as "the ropes of Maui." It is related that in former times the sun-god, Ra, was not so regular in his habits as he is to-day. In fact, he caused the South Sea islanders much annoyance by setting in the morning, or at noon, or at other inopportune times, just when his light was needed for the daily tasks of mankind. The great hero Maui undertook to cure him of these erratic habits, and the first step was to make the sun-god prisoner. This was accomplished by laying a series of six snares, made of strong cocoanut fiber, along the sun's path in the sky. When the deity next rose from Avaiki, or the land of ghosts, the first noose encircled him, but slipped down and only caught his feet; the second slipped too, but caught the sun-god's knees; the third caught around his hips. Still Ra pressed on, scarcely hampered by these contrivances. The fourth noose tightened around his waist, the fifth under his arms, and finally the sixth and last caught him around the neck and almost strangled him. Then the sun-god confessed himself vanquished, and, in fear of his life, promised Maui that he would in future adjust his daily journeys more in accordance with the comfort and convenience of mortal men. Ra was then allowed to proceed on his way, but Maui prudently declined to take off the ropes, which may still be seen hanging from the sun at dawn, and when he descends into the ocean at night. Hence the islanders say, when they behold the beams radiating from the sun, "*Tena te Taura a Maui*"—"See the ropes of Maui."

## A New Whole Wheat Flour

**By Charles Maxaner**

THE theory of modern flour-milling has been from the beginning to separate the flour substances contained in the wheat kernel from the less easily digestible shell particles. It is interesting to ascertain the reason for this practice and why it is that the contents of the entire grain, as provided by nature, are not used for making flour and bread.

In this connection we have to consider first the prevailing idea that bran is unsuitable as food for human beings, and particularly for bread-making, because of the indigestible qualities of the bran. Moreover, there is the indubitable drawback that the public demands white bread. To meet the tendency in this respect, it has been necessary to "improve" the natural color of flour by artificial means, and, as a result, flour is often treated by chemical processes, such as bleaching. The facts referred to above are the principal reasons why bread made of white flour only is still on the market. But as soon as the bran is rendered as digestible as ordinary good flour I feel confident that the preposterous demand of the public for white flour will come to an end.

Hygienists and millers well know that the most nutritious substances of the wheat kernel are contained in the hulls and not in the flour body. Therefore our main task is to render the nutrients of the bran digestible. Attempts have been repeatedly made in this direction and have resulted in the production of various kinds of bread which, however, are far from being wholly digestible. Consequently, the assertion of hygienists that bran is only a burden to the stomach still prevails. In consequence of this theory, the whole amount of bran has been put aside as unserviceable as food for human beings. This is all the more regrettable when we realize that this abandoned fourth contains more nutritive substances than all other portions of the grain. Bran is now used mainly as food for animals, but since there are many waste products from other sources which could be used for this purpose in place of bran, it would be much more important to make it thoroughly available for men.

This important subject, dealing with the chief food for human nourishment, has been under investigation and discussion for a long time in Europe by hygienists and chemists. Some time ago, Prof. Dr. Finkler of the University of Bonn, Germany, placed on the market his newly invented process which solved this problem in a most remarkable manner. Prof. Dr. Finkler ascertained that a perfect digestibility of the nitrogen in the bran could be attained if all the gluten cells of the bran were broken open and the albumen thus exposed. This effect could not be brought about by the ordinary comminuting processes, for, as mentioned above, even the most thorough grinding and pulverizing could not produce a complete breaking up of the gluten cells. Prof. Dr. Finkler's process for rendering the bran-flour as fully digestible as white flour is carried out by the application of special machines. However, as this bran-flour does not possess enough starch, it has to be mixed with white flour, usually in the proportion of 25 per cent bran-flour and 75 per cent white flour, for making bread. It will be seen that in this bread all the substances of the grain are utilized and in their exact ratio.

An analysis of this bran-flour shows that it contains approximately:

| | Per Cent. |
|---|---|
| Albumen | 18 |
| Starch | 45-55 |
| Crude fiber | 7-12 |
| Fat | 3 |
| Ash | 7 |

It will be seen from the above statement that this bran-flour is a very nutritive product because of its contents of albumen, fat, and salts (ashes). This flour is, of course, almost identical to raw bran as regards the chemical characteristics, but there is, however, a great difference between albumen enveloped by the cell walls and liberated albumen, as to the digestibility and solubility. The true importance of Prof. Dr. Finkler's process lies in the fact that the albumen contained in this new flour is rendered as easily digestible as the ordinary white flour.

The reader will be interested in knowing something about the bread made with this flour. The bread is loose and contains no trace of particles that feel gritty between the teeth; it is therefore entirely dissimilar to the old-fashioned whole wheat breads. Since the bread itself no longer contains any coarse bran-particles or unopened gluten cells, only a very small percentage of the particles of the outermost shell can be detected by means of a microscope after the consumption of the bread. Owing to its pleasant taste, I am sure that the bread will be eaten willingly.

The technical side of this invention has been so well taken care of that it will in no way interfere with the existing flour-milling systems. It will only be necessary to subject the bran, as it comes from the mills, to the special machines used for carrying out this process in order to realize a product as finely ground as the ordinary white flour. After mixing about 25 per cent of this bran-flour with 75 per cent white flour, and following the usual baking procedures, a bread furnishing more nutrients to the body and easier digestible than the bread made of ordinary white flour will be attained.

I earnestly hope that the people will realize why they should extend a hearty welcome to this new whole wheat bread which is particularly good and contains an especial nutritive value, because it is prepared from the entire grain, as God made it.

## Hunger Strikes an Aid to Good Health

**By Maud DeWitt Pearl**

RECENT scientific experiments will come as a surprise to the skeptical individual who scoffs at the numerous dietetic fads which, within late years, have been exploited in various magazines and which demand, as a preliminary stage in the treatment, a period when no food is to be eaten.

Prof. Carlson of Chicago University, whose work upon the digestive system is so well known, may be regarded as having settled definitely any doubt as to the beneficial effects of abstaining from eating for a period of time and to have proved that this feeling is not due solely to enthusiasm for a cause, as many maintain. It must be said, however, that he and his co-worker did not go to the extreme, as is so often the case with the faddist, but endured starvation for only five consecutive days. Furthermore, they were both in good health when they began the experiment. Aside from the fact that they slept in the laboratory at night, in order to facilitate making the records, they lived their regular lives, teaching and lecturing throughout the five days.

The original experiment was to investigate the hunger contractions of the empty stomach. For the purpose

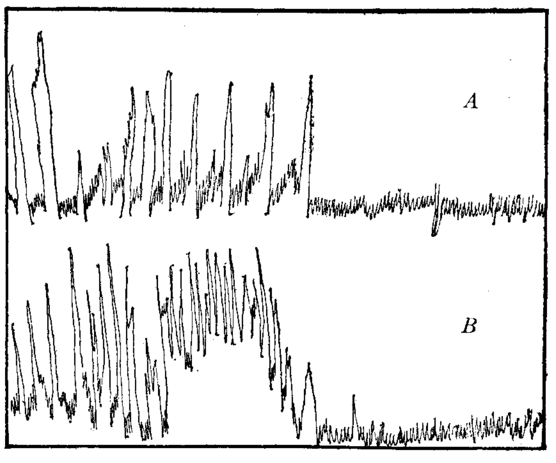



**Diagram indicating the contractions of the empty stomach during the last ten minutes of a typical hunger period.**

*A*, tracings made ten hours after a meal; *B*, tracings made after five days' starvation. Note the increase in the frequency and strength of the contractions in *B*.

of recording such contractions, Prof. Carlson used a rubber tube to which a rubber balloon was attached. The person upon whom the records were to be taken swallowed the balloon. A chloroform manometer, which was attached to the tubing at the other end, recorded the frequency and strength of the contractions. Previous experiments have shown that the normal stomach is never in a state of complete rest, but that the muscles are continually contracting and relaxing. There will be a period of strong contractions, the hunger contractions, followed by a period when the contractions are very feeble. The starvation records showed that there was an increase in the strength of the stomach contractions as well as in the frequency of the hunger periods, as the fasting was prolonged. During the night both the strength and frequency of the contractions were more pronounced than during the daytime, the records showing that during practically half the time the stomach was begging for food.

The sensations of hunger which were experienced and the hunger contractions of the stomach did not accompany each other, for after the first day and up to the end of the third hunger was continuous and severe; but on the fourth and fifth days the desire for food became greatly diminished. In the case of Prof. Carlson, his appetite remained good, but he found it fairly easy to dismiss from his mind the thought of eating. His assistant, on the other hand, did not find the sight of food at all pleasurable, but experienced a feeling of nausea. As would be expected, both of the men felt somewhat weak and depressed mentally toward the end of the experiment, but much of this disappeared after the first meal and was entirely gone by the second or third day after normal eating was resumed.

While these results are of interest to all, yet of far greater general interest are the after effects of the starvation experiments. To quote Prof. Carlson: "The writer felt as if he had had a month's vacation in the mountains. The mind was unusually clear and a greater amount of mental and physical work was accomplished without fatigue. In the writer's own case the five days' starvation period increased the vigor of the gastric hunger contractions to that of a young man of 20 to 25 (the age of the professor is about 38), and the empty stomach retained this increased vigor for at least three weeks after the hunger period, when observations were discontinued, owing to absence from the university. This improvement, or rejuvenation of the stomach, is not a matter of subjective opinion, but a matter of objective record on the tracings." While many centuries have passed since man has become a civilized being his physiological constitution is undoubtedly little altered from what it was in distant ages when, because of his primitive methods of living and his inability to cope with climatic conditions, he was forced to endure periods of hunger. Because of this he was undoubtedly in better health than his descendants.

Prof. Carlson does not maintain that starvation is a cure for ill health, although he believes that "there is more value in some of these measures than is ordinarily considered," but he does think that very possibly, in the case of adult healthy persons, not only would they experience a general feeling of rejuvenescence if they underwent hunger strikes with their digestive systems, but that possibly their length of life might be also increased.

## Drop Head, a New Ailment

**By Dr. Leonard Keene Hirshberg**

HAVE you ever heard of *Kubisagari?* Ask the next hundred or two doctors whom you meet, especially medical society physicians, what this word signifies, and you will be amazed to find how few know about it.

Kubisagari is an old disease discovered by new doctors. It is a malady which occurs in two small districts of North Japan and on the Franco-Swiss frontier.

A few instances of the disorder have been discovered in England and Canada, but no physician as yet in this country has found one example, although there are possibly hundreds of them at large in America.

Kubisagari means *drop-head.* The dropping of the head forward, to the side and backward is one of the noteworthy symptoms.

A young Japanese doctor who had just settled in a country district in the north of Japan found one day at his door a peasant with his head bent forward on his breast.

"What do you desire?" asked the young doctor.

"I have drop-head," he replied.

"What is drop-head?" asked the doctor.

"Why, our whole village is filled with this trouble," he replied.

The doctor at once became interested and reported his studies to Dr. P. L. Couchoud, who gives them to the world, so that other physicians may unearth similar instances of the trouble in their country.

The important and striking symptoms of Kubisagari or drop-head are exhaustion and flaccidity of various muscles.

Muscles of different parts of the body lose their tone very suddenly. This takes place particularly when the body is brought into action, when the muscles come into play. The eyesight also becomes affected and dizziness with vertigo occurs.

Milkmen and milkmaids, while milking the cattle, abruptly find their hands become numb and useless. The head falls forward against the cow, and the victim falls over against the cow or he rolls over on the ground. Dr. Gerlier is the one to whom has fallen the honor of finding the first sufferers in France. He noted first that the muscles of the fingers relaxed rapidly. Each spell, he says, lasts ten minutes. Sometimes they last longer, and run into each other and fuse.

Fatigue and excessive muscular exertion seem to be responsible for the origin of the attacks. The afternoon and night seem to be the most susceptible periods.

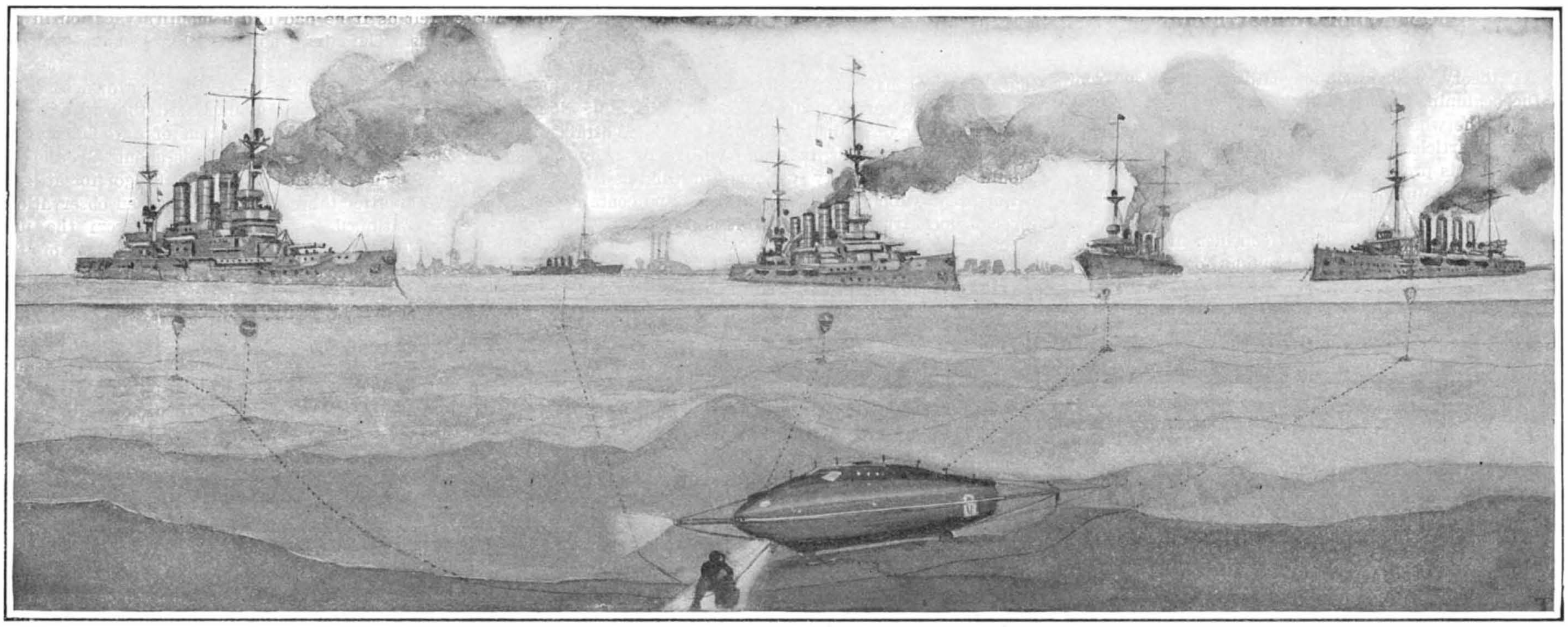
The whole illness lasts about five months. Those who work around cattle, poultry, cats, horses, and especially milk and stables, seem to be particularly associated with the affection.

Dr. Couchoud has gone even further than any of the other investigators. He has found the cause of drop-head or Kubisagari to be a little dot-shaped coccus or bacteria. It is found in the spinal fluid. If this fluid is inoculated into cats, the same disease comes into being. In brief, the cat eventually falls ill with his affliction.

They are now at work in an effort to find an antitoxin or vaccine to cure and prevent the little known trouble.

---

**Commander E. R. G. R. Evans, R. N.,** who was second in command of Scott's Antarctic expedition, and who recently lectured on the expedition in the United States, has just been appointed to command the torpedo-boat destroyer "Viking."



The mines are planted below the warships by a diver, who makes his exit through the trap-door of the front compartment. They are so planted that at a given hour, in a certain state of the tide and current every ship will be above a mine-field. The firing cables are led to the submarine, which detonates the mines simultaneously.

**Mine-planting by submarine.**

# Submarines That Are Strictly Invisible

## A Type That Can Pass Through a Mine Field and Attack a Blockaded Fleet

By Simon Lake

IT has been well established that submarine boats should be divided into two classes; one, a torpedo boat with as high surface and submerged speed as it is possible to attain, with a large radius of action, capable, if possible, of exceeding battleship speed when on the surface so that it may intercept a battle-fleet on the high seas and submerge in its path of approach before being discovered; the second class should consist of smaller, slower speed, mine-evading submarines, with torpedo and mining and counter-mining features. Such submarines are essentially defensive; but if they have sufficient radius of action to reach the enemy's harbors and to lie in wait off the entrance to such harbors, or to enter submerged the harbors themselves and there destroy the enemy's craft, they have become potent offensive weapons of the raiding fleet. For a European power it is relatively easy to give such boats the radius necessary for them to invade an enemy's ports.

I have not pushed the consideration of the submarine of the second class, with its anti-mine features, because I have been kept busy trying to profitably meet the wishes of the various governments which demand constantly increasing speeds at a sacrifice of some characteristics which I personally regard very highly. Most governments have been more attracted to vessels of the first class, as speed in all classes of vessels more than anything else seems to appeal to the imagination; but I think it may be the old story of the "Tortoise and the Hare" over again; and I refer to the recommendation of a special board, appointed in 1903, recommending the purchase of a number of Lake type boats for the defense of our own coasts as a proof of this contention.

As regards the first class of submarines, the present submarine boats engaged in the Continental war consist of vessels only a few of which have a surface speed exceeding 12 knots or a submerged speed exceeding 10 knots for one hour or 8 knots for three hours. There may be a few in commission that exceed these speeds, but very few. Some are in course of construction that are expected to give a surface speed of 17 and 18 knots for forty hours and about 11 knots submerged for one hour, or a slower speed for a greater number of hours.

Governments are asking for bids for submarines of greater speed, and some have been designed which are expected to make 20 knots on the surface. However, none of them are in service as yet. One reason that higher surface speeds have not been reached is the difficulty of securing a perfectly satisfactory high-power, heavy-oil, internal-combustion engine, suitable for submarine boat work. As soon as a proven satisfactory heavy-oil engine is turned out by the engine builders, capable of delivering 5,000 horse-power per shaft, submarine boats may be built capable of making up to 25 knots on the surface.

*Simon Lake, the inventor of the even-keel submergence submarine torpedo boat, which in its ship-shaped form with double hull and buoyant superstructure, a form covered by Mr. Lake's patents in the United States and adopted in principle by the United States, Russia, Austria, Germany, and Italy, is of the opinion that the full capabilities of the submarine boat have not even yet been fully realized. Mr. Lake has developed a great variety of submarine vessels for various commercial purposes, as well as for war, and he is well qualified, because of his great variety of submarine experiences, to discuss the possibilities of the submarine in warfare.*—EDITOR.

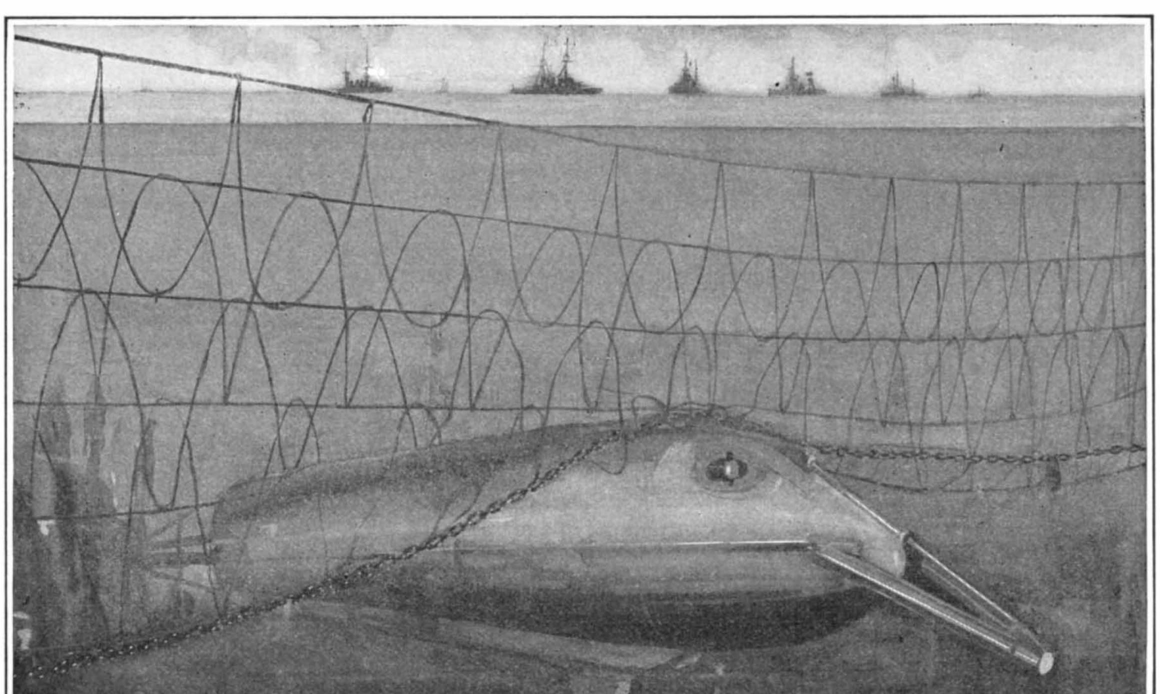
The largest heavy-oil engines so far built for submarine boat work develop about 1,300 horse-power per shaft; but rapid progress is being made, and I believe that 25-knot submarine boats will be laid down within the next two years. Even this high speed, however, will not fulfill the destiny of the submarine, which, in my opinion, is a weapon destined to promote peace between maritime nations by making it impossible for one nation to invade or harass the coast line of another nation where submarines exist, and by making it impossible for the enemy to leave their own ports or harbors with an invading army or armed vessels.

The submarine, even at its present development, has shown its superiority over the battleship in coast operations; however, to intercept a battleship at sea, even a high speed submarine must lie in wait, perhaps for days or even weeks at a time, much like a gunner in a "blind" waiting for a flock of ducks to pass within gun shot. Because of its relatively slow speed, it would have to wait a long time, also, for a battleship or fleet to pass sufficiently near to be headed off, especially if the submarine were *entirely submerged*, because the moment the periscope appears above water the quarry will take to its heels, if it follows the latest ruling of the British Admiralty, "to steam away from the vicinity of submarines at full speed, even if it is necessary to abandon a torpedoed sister ship and its drowning crew to their own fate."

I believe that this apparently heartless order is justified by the loss of the "Aboukir," "Cressy," and "Hogue," the only flock of ducks, figuratively speaking, that has come within the shot of the submarine torpedo gunner.

The conclusion must be reached, therefore, that on the high seas the only advantage the costly dreadnought has over the pigmy, cheap submarine, as at present constructed, lies in its ability to run away and to rule commerce far offshore on the high seas.

The principal means used in my mine-evading submarine are the bottom wheels and diving compartment, which were incorporated in my 1893 design, which also carried my pioneer features of lateral hydroplanes to get even keel submergence; high, watertight superstructure, which is indispensable for high-speed, ocean-going submarines; anchors, and lifting and lowering sighting instruments. Excepting the bottom wheels and diving compartment, most navies have now incorporated these features in their submarines. Three navies have adopted the bottom wheels, etc. These mine-evading craft are able to enter the enemy's own territory with impunity and destroy his merchant ships and warships in their own harbors. The "Niger" was sunk at Deal by a German



When the submarine, traveling on the bottom, reaches the net, the latter is lifted by the projecting arms and slides over the smooth body of the boat.

**Passing below protective netting.**

submarine, which is reported to have passed through a mine field. In 1902 I built the "Protector" and fitted it with the above features.

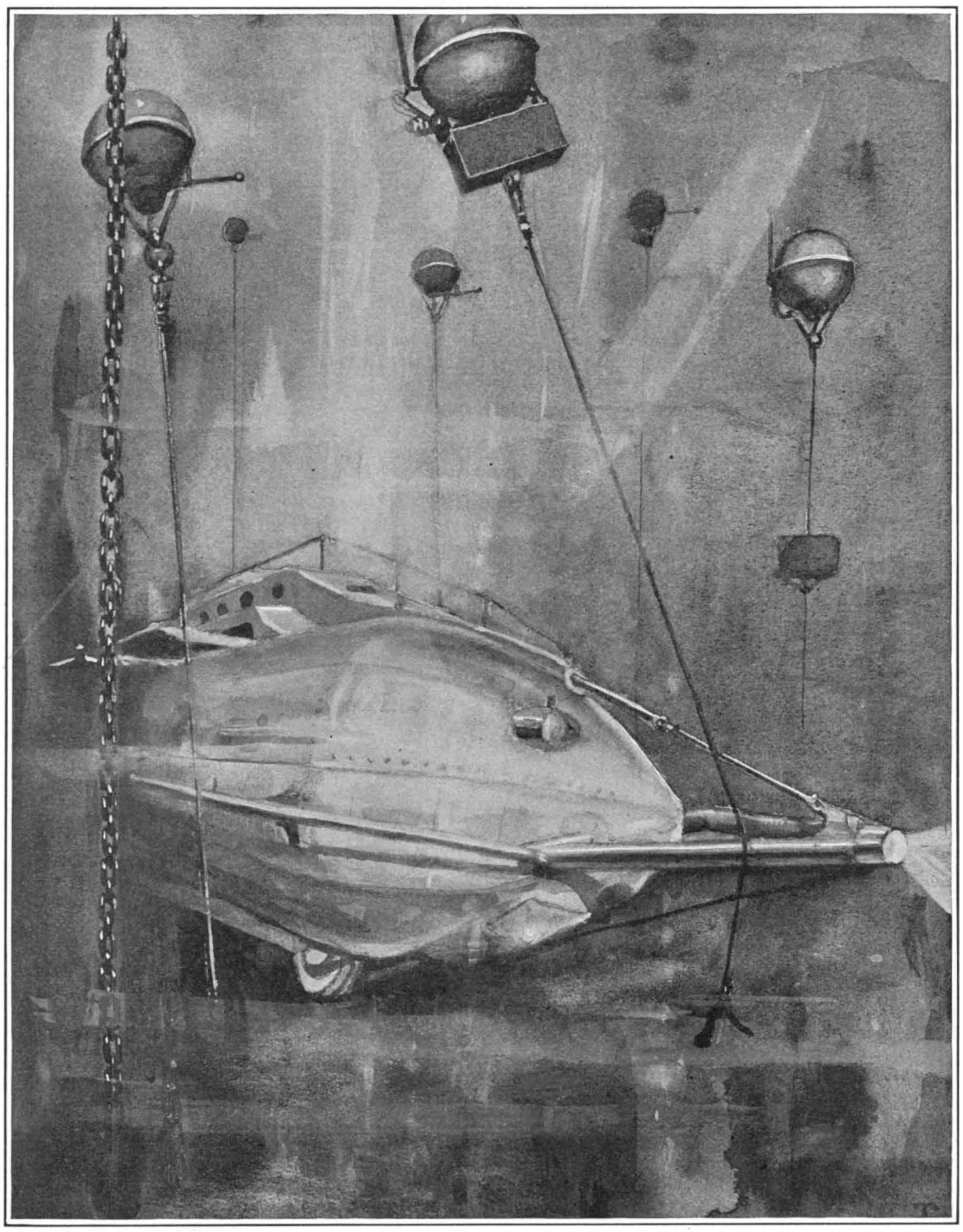
In 1903, former President Taft, then Secretary of War, appointed a Board of Officers, consisting of Major (now General) Arthur Murray, as president of the board; Capt. Charles J. Bailey, and Capt. Charles F. Parker, who reported: "It will give the nearest approach to absolute protection now known to the board. . . . The boat can lie for an indefinite time adjacent to the point to be defended in either cruising, awash, or submerged condition, by its anchors, or on the bottom ready for instant use, and practically independent of the state of the water, and in telephonic connection with the shore, or can patrol a *mined or unmined channel, invisible to the enemy and able to discharge its torpedoes at all times,*" and for the attack, "the boat shows great superiority over any existing means of attacking mine fields known to the board. First, it can be run by any field as at present installed, with but little danger from the explosion of any particular mine or from gun fire, during the few seconds it exposes the sighting hood for observation, and can attack at its pleasure the vessels in the harbor. Second and third, the board personally witnessed the ease with which cables can be grappled, raised and cut while the boat is maneuvering on the bottom; mine cables can be swept for, found, and cut or a diver can be sent out for that purpose."

Congress, however, failed to provide for the purchase of vessels of this type, although repeated recommendations were made by the general staff to do so; consequently, the "Protector" was sold to Russia, and is now at Vladivostok.

The necessity of such features as bottom wheels and diving compartment is now being brought out in the present war. I believe the mining and countermining features must be incorporated in one type before the submarine reaches its full development. The impotency of the great combined English and French fleets of battleships, cruisers, destroyers, and submarines must be galling to the people who have paid for them by the sweat of their brows. These fleets are impotent because the Germans will not come out from behind their mines and forts and wage an unequal battle against superior numbers, but prudently are sending out their submarines to destroy gradually the enemy that is trying to blockade the German ports.

Winston Churchill, the First Lord of the British Admiralty, expressed the bitterness of this impotency when he said, "If they don't come out and fight, we will go in after them and dig them out like rats"; however, the German mines and submarines stand in the way, and are themselves taking their toll of ships.

The mine-evading submarine can enter with comparative safety through a mine field, like a shuttle passing through the woof of cloth during the weaving process, and I take the opportunity to explain, for the first time, through the SCIENTIFIC AMERICAN, my method of entering harbors. To comprehend thoroughly the safety with which this is accomplished, it is necessary to appreciate the almost insuperable difficulty of discovering an object like a submarine vessel when once sunk beneath the surface of the water. There are many sunken ships containing valuable treasures and cargoes that lie along our coast, and in most of the harbors of the world, that have been known to have sunk within a radius of less than a mile from some given point, but which have never been located. Some of these vessels have been searched for for years and never been found. Dozens of vessels have been sunk in the waters of the North and East rivers and never located. Perhaps the most noted case is that of the Pacific Mail steamer "Rio de Janeiro," which sank in the entrance of San Francisco Bay, with treasure of a value of over $500,000. This large vessel went down in a fog only a short distance from land, but she has never been found. Some of the British and French submarines have been lost in localities well known, but it has been impossible to locate them.



A Lake submarine traveling on the bottom can push the anchorage cables aside by means of the guards attached at the bow.

**Passing through a mine-field.**

During several years of experimental work with submarines, investigating bottom conditions, I have traveled many miles in the Chesapeake and Sandy Hook bays, along the Atlantic Coast and Long Island Sound, and later in the Gulf of Finland and the Baltic Sea, and it is a fact that cannot successfully be disputed technically, by any one, that a submarine of the type recommended by the United States Army Board may be taken into any harbor in the world entirely unseen and remain there, if necessary, for a month at a time, and destroy shipping, docks, and war craft deliberately and leisurely, and defy discovery.

My method of entering harbors or through mine fields consists principally in providing submarine vessels with bottom wheels and other component undisclosed details. When submerged, the vessel is given sufficient negative buoyancy so that she will not be drifted off her course by the currents when resting on the bottom. The vessel is what might be termed a submarine automobile, and it may be navigated over the bottom as readily as an automobile on the surface of the earth. The submarine automobile has one great advantage over the surface type in its ability to mount steep grades or go over obstructions, because the vessel is so nearly buoyant that she will mount any obstruction she can get her bow over.

My early experience proved to me that a submarine could not be satisfactorily navigated submerged in shallow, rough water by the same method of control as was found to be satisfactory in deeper water, for the reason that the vessel would pump up and down with the rise and fall of the sea. Neither could the vessel lie at rest on the bottom as the lift of the ground swell in bad weather was sufficient, even with a considerable negative buoyancy, to cause the vessel to pound so badly that the storage battery plates would be destroyed in a few minutes. I, therefore, suspended the wheels on swinging arms and applied a cushioning cylinder. The hull of the vessel was then free to move up and down, synchronizing with the lift of the ground swell, and at the same time the weight of the wheels kept the submarine close to the bottom and able to keep her position while at rest or to be navigated over the bottom at any speed desired.

Most of our Atlantic Coast, Long Island, and Chesapeake Bay water-beds are comparatively uniform as to depths. In other countries I have navigated over rocky bottoms filled with giant boulders. A rough bottom limits the speed at which it is advisable to travel, but I have never seen a bottom so rough that it could not be readily navigated.

Lake boats, fitted with bottom wheels, have, in a competitive test abroad, entered land-locked and fortified harbors without discovery, where the entrance from the sea has been through a tortuous channel. All other vessels, except the one fitted with bottom wheels, were discovered long before reaching the outer fortifications, because it was necessary for them to show their periscopes to sight their way. They struck the sides of the dredged channel, which caused them to broach and be discovered, because they had to maintain a comparatively high speed to be kept under control. In tests carried out in Russia the boat fitted with bottom wheels simply wheeled along in the channel at slow speed and stopped and backed to change course at will. The revolutions of the bottom wheels gave the distanced traveled, the manometer gave the depth, and the compass the proper direction; consequently, with a correct chart as to courses and depths, navigation on the bottom in entering harbors is very much easier than on the surface, unless the channels are well buoyed.

Most mines, as at present installed, are either of the observation or contact type; the observation mines are fired usually from shore stations when the enemy is seen to be over them, while the contact mine is anchored a few feet beneath the surface and is either exploded by contact with the surface of the vessel's bottom or by the agitation caused by the rush of water due to the swiftly passing vessel. The European belligerents have put out contact mines to protect their capital ships from the submarines. The dread of these mines is holding the submarines outside of the mined areas and the mines are, therefore, effective. None of the British vessels are fitted with bottom wheels and diving compartments, and they must be navigated at such speed to keep submerged control that they would explode a contact mine if either the mine or its anchor rope was touched. This also applies to some of my later boats, as the bottom wheels have been omitted to meet the demand for greater speed on the surface and submerged.

I am inclined to the belief that this has been more or less of a mistake, because the bottom wheeled submarine can go to and "dig" the enemy out of its base, in addition to hunting the big surface craft of the enemy on the high seas.

With the bottom wheels, navigation can be conducted so carefully over the bottom that inspection of the

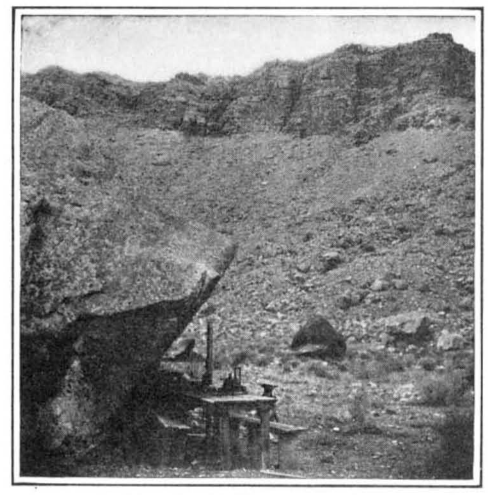
*(Concluded on page 74.)*

On the trail to the mine in the crater.

# A Mine in a Meteor-Made Crater

## Work of a 15,000-Centimeter Celestial Projectile

By Arthur Chapman



Anvil rock at the bottom of the crater.

UNIQUE mining operations have been carried on, until recently, in the crater of what is known as Meteor Mountain, near Canon Diablo, Arizona.

This is not a volcanic crater, but was formed by the fall of a tremendous meteor in some past age. Scientists who have examined the crater are of the opinion that the meteor which struck the earth there must have been of almost incalculable size and weight. In fact, there is no indication anywhere else of the alighting of a meteor approximating the size of this Arizona visitor.

Acting on the theory that the meteor was of such great weight that it sank into the ground to an extreme depth, a mining company expended much money in driving holes at the bottom of the crater in a search for the main body of the deposit. Five shafts have been sunk at the bottom of the crater, the longest being 125 feet deep. Quicksands and silica, encountered at that depth, prevented further sinking. From the bottom of the deepest shaft borings have been run down to solid formation, but no trace of the meteor has been found.

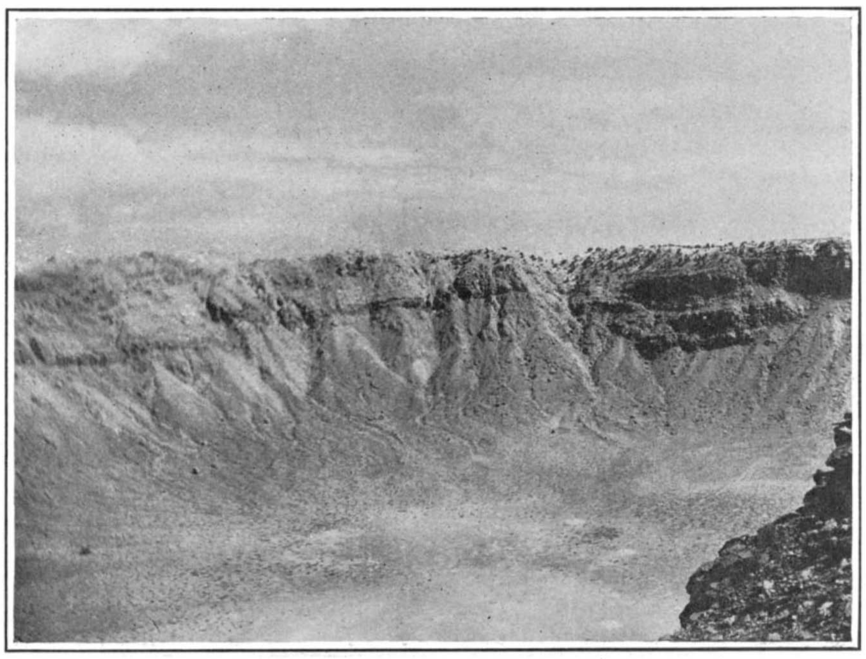
Several years ago a sheep herder discovered some of the meteoric fragments and this led to further investigation, and it was found that the large hill rising from the level desert, near the spot where the herder had made his discovery, was the rim of a great crater. More fragments were found near this crater, and soon it became the generally accepted theory that a meteor caused the strange formation in the desert, which at first had been ascribed to volcanic action.

The hill itself does not deserve the term "mountain," as it rises hardly more than 150 feet from the level of the desert. The crater is three quarters of a mile across and is from 300 to 400 feet deep. There are 300 acres in the bottom of the crater, giving ample room for the mining operations which have been carried on.

So far as its shape is concerned the crater could have been formed equally as well by a blowout as by impact; but the character of a portion of the ejected material points strongly to an impact as the origin. The evidence afforded by other meteoric bodies, in regard to the results in impact and the disturbance of the surface of the earth, is very contradictory and is of little assistance in deciphering the gigantic disturbance here found, for nothing equaling it in size has ever been discovered.

This Arizona meteor must, by the evidence at hand, have struck with sufficient force to crush a layer of limestone 300 feet thick, having an average crushing strength of 12,595 pounds per square inch, and, further, of a layer of sandstone 500 feet thick with a crushing strength of 6,350 pounds; and to meet these conditions the hypothetical case is conceived of a mass of meteoric iron 500 feet in diameter and striking the earth at a speed of five miles a second. The superficial rocks are crushed and thrown back to an amount greater than the bulk of the meteor, and as a projectile under similar conditions will create a crater eight to ten times its diameter the supposed 500-foot projectile could easily have formed the 3,900-foot crater that exists in Arizona. As this huge projectile penetrated below the surface the upward escape of material around the mass would be impeded, and that directly in its path and also that on the sides would become greatly compacted. The heat generated by the rapid downward passage of the body would produce fusion and probably also a partial volatilization and the effect of the impact would convert any moisture present into steam of great explosive power. The result would be that quantities of the surrounding material, together with portions of the meteor itself, would be ejected and thrown back over the rim of the crater and scattered over the surrounding plain. Such is a hypothetical reproduction of the event which would explain this curious crater and the conditions that surround it.

Meteor Mountain is ten miles from Volz's trading post at Canon Diablo, in the heart of the grim Southwestern desert, and is visited by few people. Yet it is one of the most interesting natural attractions of the Southwest. It is believed mining operations will be taken up again and that some way will be found to penetrate more deeply beneath the crater and ascertain whether the greatest of meteors is resting, as many believe, in a solid mass hundreds of feet below the level of the Arizona desert, or whether there is nothing left of the original body of the meteorite but the scattered material now found upon the surface.



The enormous pit produced by the impact and explosion of a giant meteorite.

Meteor Mountain in the background at the right.

### Slaughter in Mines Rivals War

BECAUSE war is a comparative novelty and its horrors are presented to us in appropriate descriptive settings we shudder at its useless slaughter, entirely unmindful of the fact that much more unjustifiable killing is going on daily in our midst as the result of the manner in which some of our commercial enterprises are conducted.

The report of the Bureau of Mines, just issued, shows that during the year 1913, 3,651 men were killed in the mines and quarries of the United States, and the number injured during the same period is estimated at 100,000. This means that nearly three and one half men were killed for every thousand employed, which Dr. Joseph A. Holmes, director of the bureau, declares to be "excessive and unnecessary and a discredit to the industry." Commenting further, he says:

"When we consider that this record is being repeated year after year, the very thought of it becomes appalling. In the last three years, as far back as the records of the Bureau covering certain branches of the industry go, the mines and quarries of the United States have swallowed up 10,487 human lives and have incapacitated temporarily probably a quarter of a million men. And the saddest part of it all is that a great part of this death roll, and a still greater part of the injuries, are not necessary. I believe I am conservative when I say that half of the 3,651 men killed in the year 1913 might have been saved and three fourths of the 100,000 men injured in the same year might have escaped injury had all the various agencies involved, the operators, the miners, and the State and National Governments, done their full duty in the matter. Perhaps no one of these agencies has done its full duty. For the Bureau of Mines, as representing the Federal Government, I can say that, owing to a lack of adequate funds, this Bureau has fallen short of doing its full part in this great safety movement; and I therefore hesitate to criticise the seeming shortcomings of any other agency."

These employments, from their nature, must always be hazardous; but the record of European countries of only one man per thousand killed in similar work shows that the above estimate of the easily possible saving of life can and should be realized.

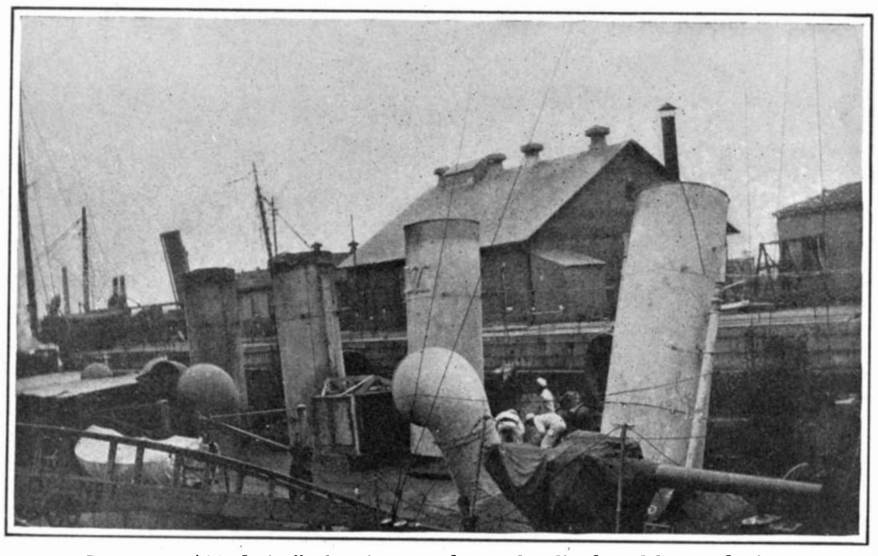
### Marconi Company Wins Again

IN the suit of the Marconi Company against the DeForest Radio Company and the Standard Oil Company for infringement of certain Letters Patent, in which Judge Hough recently granted the Marconi Company a preliminary injunction, the Court has handed down another decision. It appears that subsequent to the former decision the defendants moved to suspend the injunction pending an appeal, in so far as it related to the boats of the Standard Oil Company, and also another motion to vacate or modify the injunction with respect to both the defendants. These motions were brought upon additional affidavits, but Judge Hough, in a decision filed recently, denied all of the motions, thus refusing to suspend the injunction as to the Standard Oil Company, and to vacate or modify the injunction as to both defendants.

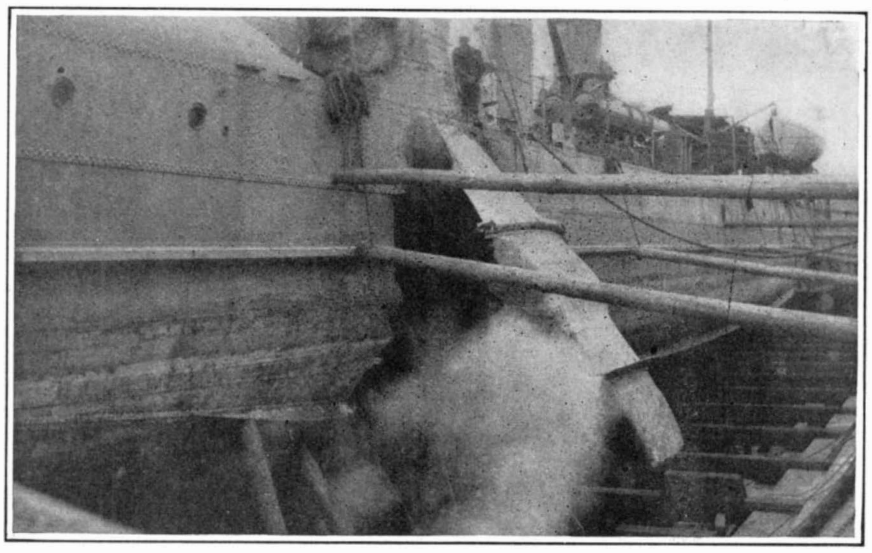
## Unprecedented Accident to a Torpedo-boat Destroyer

THE two photographs herewith presented show the result of a boiler explosion which came very near sending one of our latest destroyers to the bottom. The destroyer concerned was the "Aylwin," one of the latest to be designed and built for the United States Navy. This fine vessel and those of her class are about 300 feet in length on the water-line, 30½ feet beam, and 8½ feet draught. Their displacement is about one thousand tons and their speed 29 to 30 knots. The accident was not due to any defect in the vessel itself, but resulted entirely from a defect in the new type of boiler which had been installed on this vessel. The boilers are of the water-tube type, and it was the right-hand lower drum which gave way, the drum being blown off against the ship at about the turn of the bilge. The heavy blow thus struck, together with the pressure developed by the large amount of water which suddenly flashed into steam, served to tear open the starboard side of the boiler room and to produce the extraordinary rent which is shown in our view of the "Aylwin" when she was in drydock for repairs. The accident occurred in the forward boiler room and to the forward boiler of two which occupied this compartment. The explosion caused a leakage in the after boiler room bulkhead, so that two compartments were filled, with the result that the draught increased from 8 feet 5 inches to 13 feet 6 inches. The serious nature of the accident was aggravated by the fact that there was a heavy head sea running off Cape Hatteras, where the explosion took place; and the working of the water within the ship caused a considerable working of the engine room bulkheads, which the officers and crew endeavored to correct by bracing the bulkheads with wood and the furniture of the ship.

The wounded were conveyed to another destroyer, which took them at 30 knots' speed to the nearest hospital. The "Aylwin" was taken in tow and, in spite of her seriously damaged condition, was brought safely to Newport and placed in drydock.



**Destroyer "Aylwin," showing smokestacks displaced by explosion.**



**"Aylwin" in drydock, showing a strip of her side, 15 feet wide, blown outward by the boiler explosion.**

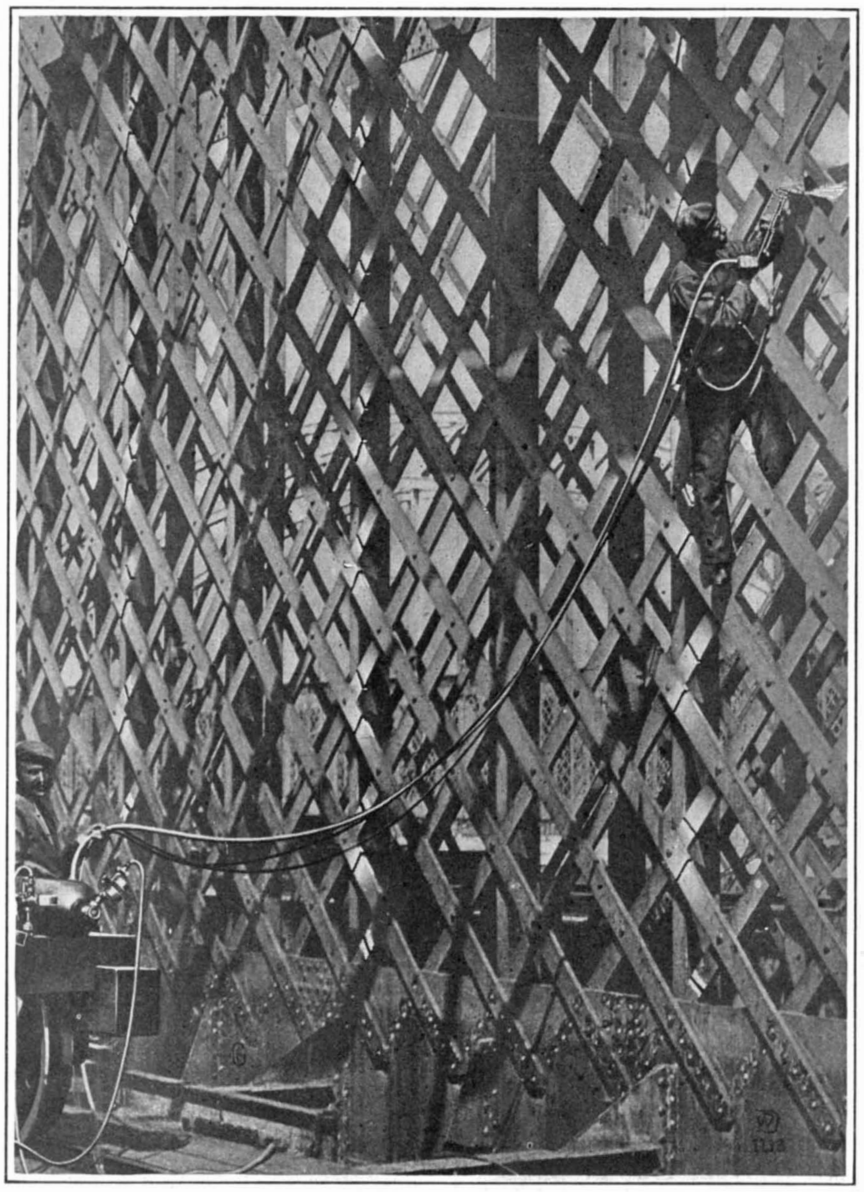
## Cutting Up a Bridge With the Oxyhydrogen Torch

IT is well known that the oxyacetylene or oxyhydrogen torch is very useful in cutting up old structural iron work that has to be removed in sections; for it provides the easiest and quickest way of cutting through the material. Ordinarily the metal has to be "pre-heated" to the point of ignition when it is actually burned by combining with the oxygen. Ordinarily the "pre-heating" of the metal is continued during the entire process of cutting. However, there is a system in use in Germany, in which the work is merely started with the oxyhydrogen flame, and once the metal has reached the proper temperature the cutting is continued to the end by supplying it with oxygen alone.

This process is illustrated by heating a piece of iron wire in the flame of a Bunsen burner and then sending a stream of oxygen upon it, when the iron will be found to burn with brilliant sparks. A special form of blow pipe has been devised to carry out the same principle on a large scale. First, tubes lead in oxygen and hydrogen to produce the pre-heating flame, and then means are provided for cutting off the hydrogen and permitting the oxygen alone to strike the glowing spot. This results in melting the metal and cutting it rapidly.

The accompanying photograph shows the work of one of these torches in cutting up an old bridge over the Rhine at Cologne. The upper part of the structure was first cut up into short sections, which were removed one after the other, leaving the floor structure intact. After that a pair of caissons were floated under the floor and when the latter had been cut free with a blow pipe water was pumped out of the caissons, permitting them to rise and lift up the structure. Thereupon, it was successfully transported some distance down the river and finally landed on a neighboring bank.

Here the floor of the bridge was further cut up into small parts by the use of the oxyhydrogen torch.



**Cutting up an old bridge over the Rhine, at Cologne, with the oxyhydrogen torch.**

## Our Beginnings in Camphor

A DOZEN years ago the Government was distributing broadcast throughout Florida a bulletin of immense import, setting forth the excellent results of a prolonged series of experiments in camphor-raising in this mild climate, and urging that every citizen of the peninsula, whether rural or urban, should set out as many camphor trees as the ground around his home would allow. If all one's ground space should be taken up with food and fruit plants, the argument proceeded, still there were the walks and roadways to be lined. And what more beautiful, symmetrical or delightfully umbrageous than the vividly green and gracefully branching camphor trees?

The realization had come home to our nation, about that time, with especial force and significance, that Japan had a monopoly of the camphor trade; hence, a monopoly of one of the most important sinews of war.

The propaganda waged at that time, both by bulletin, by experiment stations, and agents from the Bureau of Plant Industry, is at last showing fruitage. The camphor plantation at Satsuma, Fla., began recently the distilling of the present year's "crop," and the yield promises to be enormous. This is the first and only bearing plantation of any size in the United States. Its initial effort at distillation was made last season, over 10,000 pounds of crude gum being turned out.

The present year's yield promises to be many times that amount. There are over 2,000 acres in trees, and it is expected that 500 additional will be set during this winter.

Other smaller plantations in different parts of the State will shortly come into bearing and many others will soon be set out. Besides this, countless small farmers and truck growers have a few rows of these valuable trees or a border of them around their fields, and, as the business progresses, the crops from these will either be regularly distilled at home or else hauled to community "stills." The outlook now is that within another dozen years or less the camphor trade of the United States will be revolutionized. The monopoly of Formosa will be a thing of the careless past.

## Iceland's Railway

FOR years the people of Iceland have been planning to build a railway on their island and at last their hopes have been realized. The Althing, or Iceland Congress, has passed the bill, and at no very distant date the steed of steel will worm its way between the glaciers and among the hot springs of Iceland.

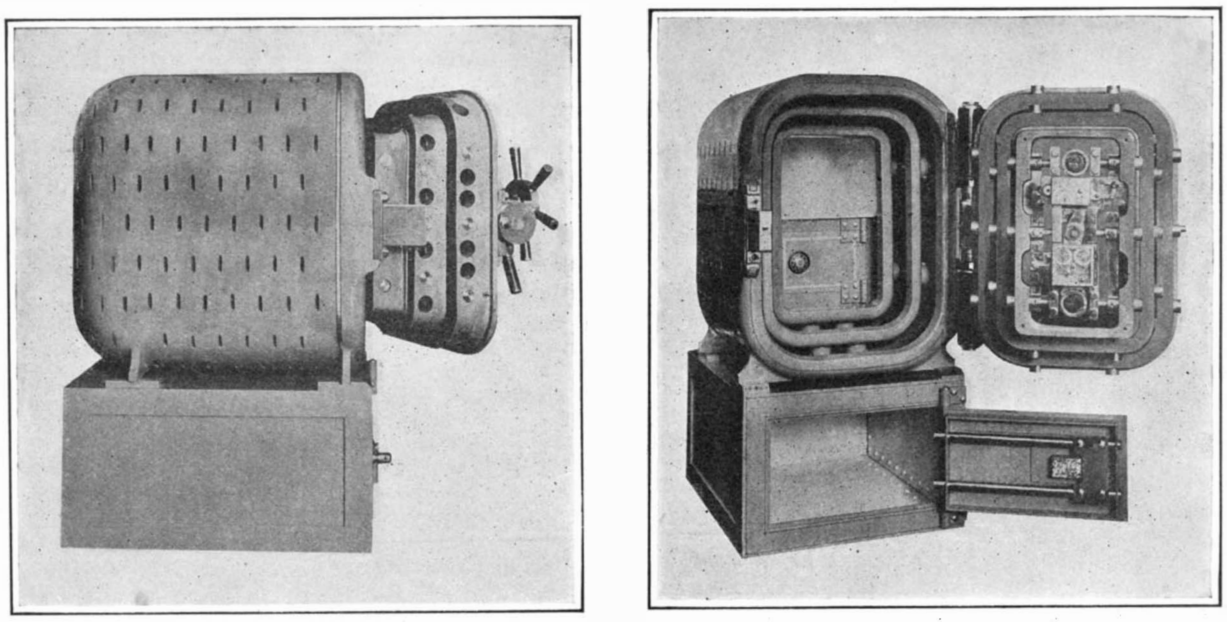
The main line of this railway will run from Reikjawik, the capital, to Thorsjaa; here the road will divide, with one branch to the geysers and the other to Oerbak. The total distance to be covered by rail is about 100 kilometers, or about 62 miles, and the system is to cost approximately $1,000,000. At the present time the facilities for traffic and trade are still most primitive. Travelers are obliged to ride on any animal which may be available, while freight is moved in rude carts. The roads are for the most very bad and they are often made impassable by mountain torrents.

## Early Use of Pilot Balloons

A NOTE in the *Monthly Weather Review* calls attention to the fact that the famous exploring expedition sent out by the French government under La Pérouse in 1785 carried a few small balloons, some of paper and some of goldbeaters' skin, for use in studying the winds in the upper atmosphere, and that the instructions prepared for the expedition by the Academy of Sciences pointed out the special importance of using these balloons in the trade-wind region in order to ascertain at what altitude the direction of the wind changes in that region. Thus the recent soundings of the trade winds carried out under the direction of Prof. Hergesell appear to have been anticipated by more than a century.

## Explosive-proof Safe

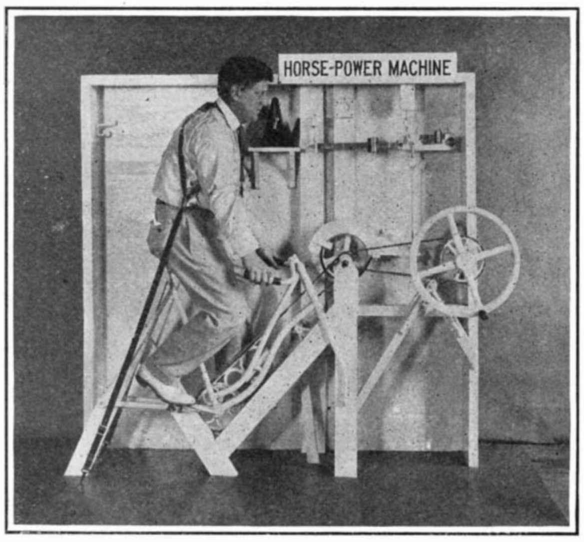
UNLESS he is provided with an oxyacetylene or oxyhydrogen torch, a burglar will find great difficulty in opening the safe shown in the accompanying photograph; indeed, the task may be considered well-nigh impossible. The safe is constructed with three walls of manganese steel, the outer and middle walls being perforated, the inner walls solid. These walls are separated by air spaces. The perforations in the outer walls do not register with those in the middle wall, so that it is impossible to work a drill through from the outside to the solid interior wall. There are three doors of manganese steel, one for each wall, each with its own set of bolts, and all arranged to swing on a single hinge. The object of perforating the walls is to preclude the possibility of confining gases generated by explosives and thus thwart the bank robber who depends upon blowing open a safe with nitroglycerin. To prove the efficiency of this safe, a test safe was made of soft steel with its door held in place by ⅝-inch cap screws in place of the regular bolts. Five and a half ounces of nitroglycerin were exploded behind the outer walls of the safe without doing any damage, and after the explosion the door opened freely.



Safe constructed with perforated outer walls to prevent confining of gases generated by explosives.

## The Horse-power of a Man

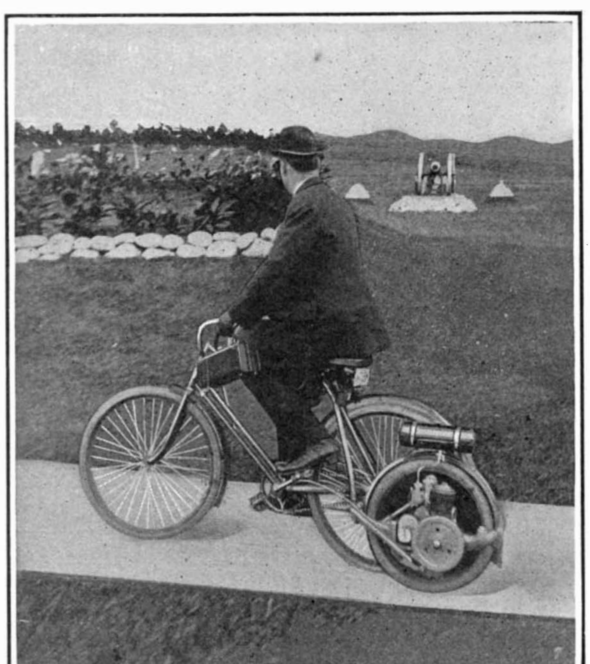
THE superintendent of a sanitarium in Battle Creek, Mich., has invented an apparatus for testing the strength of his patients and recording it in terms of horse-power. The machine consists of a bicycle with its front and rear wheels removed and its sprockets geared to a brake wheel. Straps run over the shoulders of the individual whose strength is to be tested and are attached to the floor. This enables him to use more power on the pedals. In the test he is required to keep the machine going at a predetermined rate. While he works the brake is gradually applied on the brake wheel, until the friction load is such that the rider is unable to "make the grade." The period at which he is forced to give up determines the horse-power he is able to develop. With this machine it has been shown that the average horse-power of a normal man is one fifth and that of a woman one tenth.




Testing the horse-power of a man.

## Toothless Saws for Cutting Stone

IT may not be generally known that stone is cut with toothless saws which run in continual contact with the stone and with steel shot that is constantly being poured into the saw kerf by means of an automatic spreader. As a lubricant, lime is used. The steel shot consists of small balls, 1/32 inch in diameter. In the cutting of sand stone these toothless saws cut about three inches per hour, while in granites, which offer a great resistance, the action is very much slower. Some of the saws have pieces punched out of them every foot or so, to a depth of 2 inches, in order to carry the stone "sawdust" in the kerf to the end of the stroke. The accompanying photograph depicts a number of slabs of stone that have been cut with saws, and also a number of the saws, showing their warped condition after they have been used for a period of seven days. At the top is shown a saw before use.



Bicycle converted into a motorcycle.

## Auxiliary Motor Wheel for the Bicycle

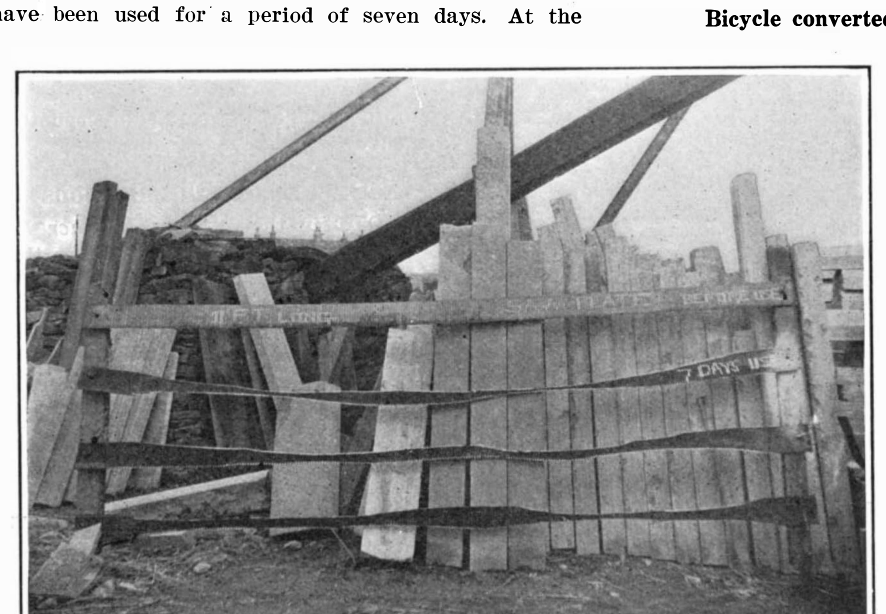
ANY bicycle may be converted into a motorcycle in a few minutes by attaching the motor wheel illustrated in the accompanying engraving. It consists of a compact power plant mounted on a small wheel fitted with a heavy motorcycle tire. It furnishes enough power to carry the rider a hundred miles on a single gallon of gasoline. The motor is a one-cylinder four-cycle engine with high tension magneto and carbureter. The driving gear and gasoline tank are also carried on the motor wheel. The motor is controlled by a lever attached to the handlebars, and both bicycle and motor are therefore under perfect control of the rider. The device may be very quickly attached to the bicycle frame beside the rear wheel.

## A Gasoline Switching Locomotive

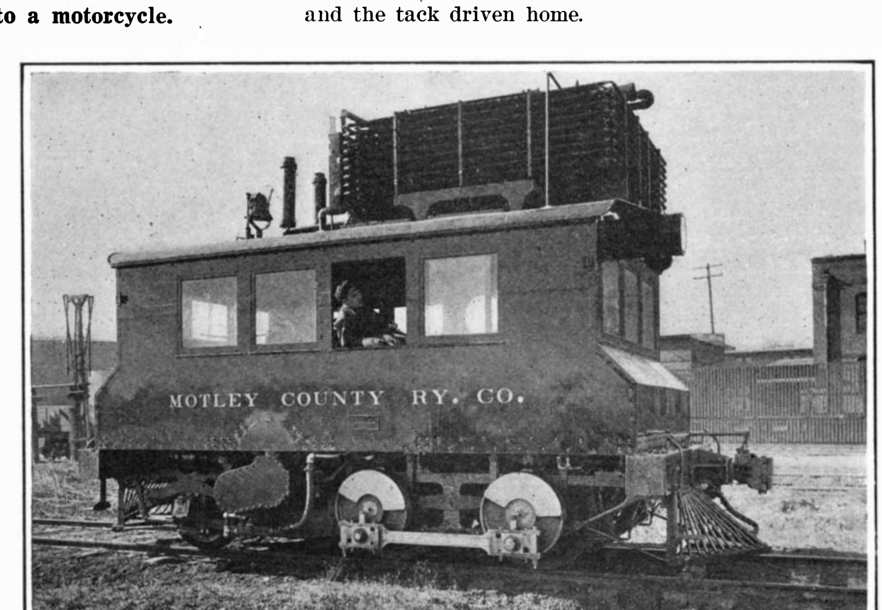
IN some places it is considered a luxury to use a switching locomotive because of the expense of maintenance and the consumption of fuel while the locomotive is not in service. Hence, unless there is enough work for the locomotive to do the twenty-four hours of the day the work of switching is done by the engines of freight trains. In order to provide a suitable locomotive for such conditions, in which there will be a minimum of expense for operation and no expense during the idle hours of the locomotive, a gasoline switching engine has been designed and is now in use at Matador, Texas. A photograph of this locomotive is shown herewith. It has a 300 horse-power engine and exercises a tractive effort of 12,000 pounds, at six miles per hour. The engine is of six-cylinder type, with cylinders 11 by 15 inches. The power transmission, which is pneumatically operated, is effected by means of a sprocket on the crankshaft connected by chain to a sleeve working free on the rear driving axle and is then transferred under multiple disk friction-clutch to the forward driving axle, where, by an octaroon clutch, the power is either magnified by a series of gears to produce heavy tractive effort and high torque for starting processes, or is delivered direct to the driving wheels. Once the locomotive is in motion the gears are cut out, and it is operated by the direct connection.

## Holding Tacks for Driving

IT is usually found difficult to hold a small tack in place for driving, and this is especially true for round-headed tacks or small nails. M. Rene Engel of Paris uses an ingenious holder which anyone can make. Take a strip of sheet metal and cut a narrow slot in one end just large enough to allow a small nail to pass in easily, then fold the strip at the middle so that it takes the shape of a pair of pincers. The tack is placed in the slot so that the head can be gripped by the pincers, and the tack thus held firmly can be placed at the desired point in the wood. Striking the top with the hammer drives in the tack, then the piece is removed and the tack driven home.



Toothless saws for cutting stone.




A 300 horse-power gasoline switching locomotive.

## RECENTLY PATENTED INVENTIONS

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

### Pertaining to Apparel.

BRACELET.—C. F. TROMMER, 30 W. 36th St., New York, N. Y. This bracelet is formed of sections connected with each other by normally concealed means which allow the bracelet to enlarge in diameter when pushing it over the hand onto the wrist, and to then contract automatically when reaching the wrist, so that the bracelet is not liable to accidentally slip off the arm and become lost.

SHOE HEEL BURNISHING WHEEL.—C. J. J. STRAESSLE, Box 577, Lynn, Mass. It is the design of this invention to provide a burnisher in which an annular burnishing means on the exterior of the wheel is adapted to yield and to automatically conform to the curvature of the heel at the point of contact.

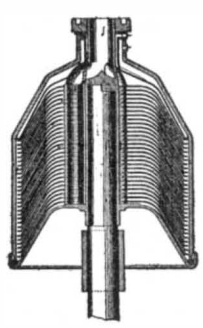
SHIRT.—L. D. LIVINGSTON, 547 Broadway, New York, N. Y. The invention provides useful improvements in shirts, notably shirts made of silk, mercerized cotton and other soft materials, and whereby the bosom portion at the collar bone of the wearer is protected against undue wear and soiling, thus insuring long life to the shirt.

PUTTEE.—A. D. MOLONY. Address care of Day, Davies and Hunt, 321 High Holborne, London, W.C., England. This invention has for its object, *inter alia,* to add comfort to all forms of puttees for hard wear, especially military, without diminishing their strength; and to adapt puttees, as neater, more efficient and comfortable articles of wear, to many new uses, chiefly sporting, for which the gaiter or combination of Highland spat and stocking have been worn hitherto.

### Of Interest to Farmers.

COTTON CHOPPER.—F. ANDERSON, R. F. D. No. 1, Lindsborg, Kan. In this invention a chopping hoe is given a rotary parallel movement transverse to the direction of travel of the machine, in which the hoe and its operating means are mounted to be shifted laterally in either direction, and also to be rocked in a vertical plane without breaking the driving connection with the actuating means.

CREAM SEPARATOR.—F. A. FALK, Stacyville, Iowa. Mr. Falk's invention comprehends an improved construction of separator making use of centrifugal force, the various movable parts of the separator being so arranged as to



CREAM SEPARATOR.

render the separation as nearly positive as possible, and to prevent the mixture of the cream with the heavier portions of the milk after the separation of the cream therefrom.

### Of General Interest.

WATERPROOFING COMPOSITION. — F. MONFORTE, Box 267, Otisville, N. Y. An object here is to provide a composition which will render leather, such as that used for shoes, boots and the like, waterproof. The composition of matter provided will render leather waterproof, while possessing ingredients which tend to prolong the life of the leather.

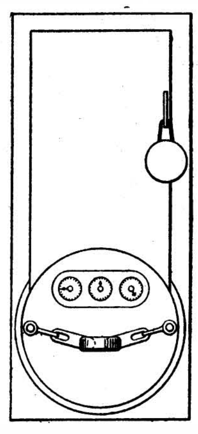
REMOVABLE SUPPORT FOR SIDES OF CONCRETE MOLDS.—D. W. DALEY, 1221 Lynn St., Parkersburg, W. Va. In molding the walls of concrete or cement structures it is necessary to support horizontally and at different heights the side boards of the molds between which concrete or cement is to be poured to form a section of the wall. The inventor's improved apparatus carries out this purpose.

CULVERT.—W. H. FRANKLIN, Box 608, Red Lodge, Mont. This device is composed of reinforced cement or plastic material capable of hardening and of sectional form, the sections and the reinforcements being so constructed and arranged that the sections may be rigidly connected together to provide for culverts of various lengths.

HORSE OVERSHOE.—C. A. DEUSCHER, 223 St. Anns Ave., Bronx, N. Y., N. Y. In this invention a horse overshoe plate is provided of peculiar and simple construction, the same having secured thereto in a rigid permanent manner a plurality of lugs or ears serving as connecting means for the overshoe.

CATHETER CASE.—O. B. SCHELLBERG, 1058 Southern Boulevard, Bronx, N. Y., N. Y. An object here is to provide a case in which the catheter may be inclosed and the whole subjected to a sterilizing heat, whereby the catheter will be effectively sterilized and may be maintained and carried in a sterilized and aseptic condition until required for use.

METER SEAL.—J. G. GORGEN, care of M. Bretz, 747 10th Ave., New York, N. Y. This invention relates to improvements in seals, and particularly to seals for meters, and has for an object to provide an improved structure which



METER SEAL.

must be destroyed before the meter can be opened. Another object is to provide a seal which can be readily applied and also readily removed by breaking, the structure being such that the broken parts cannot be disengaged.

### Hardware and Tools.

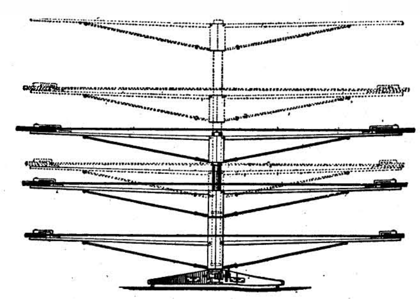
SAFETY RAZOR BLADE HOLDER.—R. E. BROWN, care of American Hone Co., Olean, N. Y. This device is for use for holding a safety razor blade during the operation of honing or stropping the blade. Safety razor blades are exceedingly difficult to handle without danger of accident, and the difficulty is increased because of the fact that the honing and stropping of the blade are done quickly. The invention overcomes this difficulty.

### Heating and Lighting.

ELECTRIC STOVE.—W. V. HARDY, Indianola, Miss. The purpose here is to provide a device especially adapted for heating press boxes, and wherein the arrangement is such that the stove may be placed within the box to heat the same, and wherein the box is provided with heating elements supported out of contact with the box.

### Household Utilities.

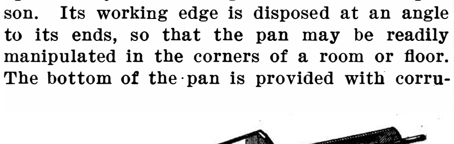
CLOTHES REEL.—J. T. PILKINGTON, Route 4, Armstrong, British Columbia, Canada. Each endless line carried by the respective sets of arms can be entirely filled with clothes from a doorway or other convenient position by merely lowering the arms by means of the reel



CLOTHES REEL.

until the uppermost set of arms are lowered enough to be easily reached. The reel is then turned until the top set is raised above the doorway and the second set brought into use, and so on.

DUST PAN.—A. E. GLOTFELTY, 229 South 9th St., Connellsville, Pa. This pan is of substantially double construction, capable of being operated by either a right or left-handed person. Its working edge is disposed at an angle to its ends, so that the pan may be readily manipulated in the corners of a room or floor. The bottom of the pan is provided with corru-



DUST PAN.

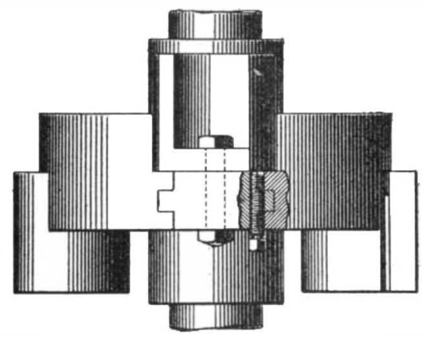
gations disposed at an angle to the working edge and directed toward one of the forward corners of the pan, so that dirt contained on the pan may be readily concentrated toward that corner to facilitate rapid dumping into a small receptacle. Means provide for preventing loss of dust from the bottom and for the removal of dust from the same.

TABLE.—G. D. TOLMAN. Address R. L. Clark, 157 Main St., Oshkosh, Wis. The aim in this case is to provide a table of the folding type wherein the supporting legs are foldable closely upon the body of the table to permit the table to be stored in small space, and wherein mechanism is provided for holding the legs in extended position firmly and rigidly to provide for a rigid table.

MOP.—W. H. ZACHRY, care of Atlanta Variety Works, 90-92 Humphries St., Atlanta, Ga. One of the principal objects of this invention is to provide an improved reversible mop head and one which is adjustable with relation to the handle. Another object is to provide means for detachably securing yarn or other mop material to the mop head.

### Machines and Mechanical Devices.

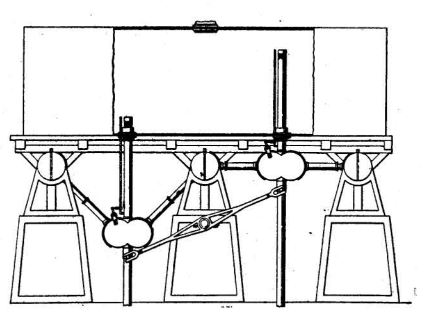
INTERCHANGEABLE CUTTER HEAD.—J. M. CRAWFORD, 1200 Missouri St., El Paso, Tex. This cutter head is designed especially for use in sash and door factories where many designs for sticking and many thicknesses of stock are used. This cutter head will work in the stock department or on stock work just the same as any other cutter head, but is designed



INTERCHANGEABLE CUTTER HEAD.

especially for special order mills or departments where it is necessary to carry a large number of cutter heads to meet the requirements. To every design of sticking and every thickness of stock there must be a cutter head, or on an average of from 10 to 12 to the machine. With the present head only one is needed.

PUMP.—J. E. WEAVER, Box 272, Twin Falls, Idaho. This invention relates to pumps and has reference more particularly to balanced compound pumps of the reciprocating type provided with translating plungers and swinging, reciprocating members. An object is to provide a simple, strong, durable, and efficient



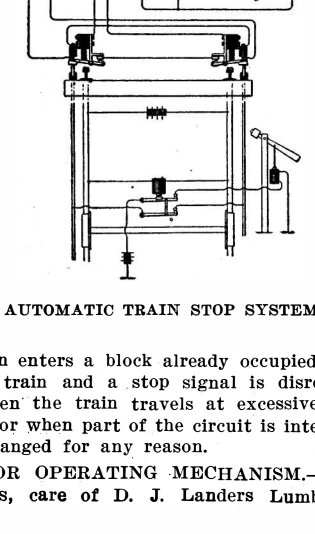
PUMP.

pump in which the power required to pump liquid is reduced to a minimum by balancing the moving parts of the pump. The engraving represents an elevation of an embodiment of the invention partly broken away to show the details of construction of the translating plungers.

REFRIGERATING MACHINE.—J. F. HAWLEY, 341 South Morengo Ave., Pasadena, Cal. In this apparatus the refrigerating medium is dry air, cooled by the evaporation of water, alcohol, or other suitable volatile liquids, in accordance with the degree of refrigeration desired, and wherein the rarefied current of cooled air may be used directly or indirectly, as for instance, in a container or in a cooling coil, in the usual refrigerating and ice-making machine.

### Railways and Their Accessories.

AUTOMATIC TRAIN STOP SYSTEM.—E. G. MASCARENHAS, Rua Dirieta, Juiz de Fora, Brazil. This train stopping apparatus is adapted for use in connection with a block signal system, whereby a train is automatically stopped or slowed down or a signal given when



AUTOMATIC TRAIN STOP SYSTEM.

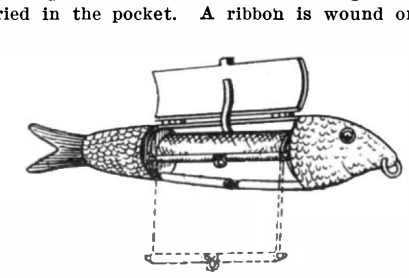
a train enters a block already occupied by another train and a stop signal is disregarded, or when the train travels at excessively high speed or when part of the circuit is interrupted or deranged for any reason.

DOOR OPERATING MECHANISM.—W. E. HARRIS, care of D. J. Landers Lumber Co., Lebanon, Mo. This door operating mechanism is especially adapted for freight car doors, or other doors of like character, arranged to slide over and away from over the door opening, wherein a track bar is provided pivoted intermediate its ends for swinging movement, the door being mounted to run on the track bar.

CAR COUPLING.—H. R. SWAN, SR., 938 Fifth Ave., Huntington, W. Va. The invention provides an arrangement, including details of construction, whereby a gravity latch member may be utilized upon the tail of the knuckle and the parts moved to and from closed position without the destructive friction and danger of breakage existing in couplers at the present time, and it further provides a connection by means of which the latch members when raised will be automatically held in such position.

### Pertaining to Recreation.

TOY.—B. O. WAKEFIELD, Rogers, Ark. This invention is a toy or amusement device, having preferably the form of a diminutive carp or sucker, and adapted to be worn as an appendage of a watch chain or as a badge or carried in the pocket. A ribbon is wound on a



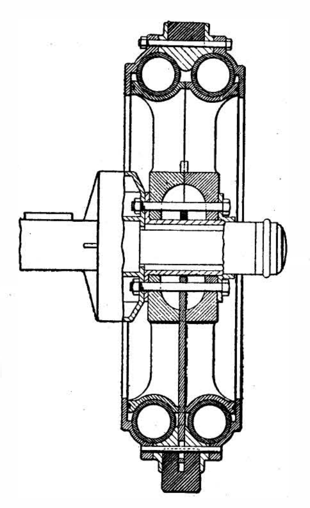
AMUSEMENT DEVICE.

roller or a drum journaled in the hollow body of the device, and, in practice, it bears photographs or other pictures of persons, landscapes or other things, or is provided with printed matter of any desired character.

### Pertaining to Vehicles.

LIQUID GAGE.—W. H. HOUT, Warrensburg, Mo. The inventor provides a gage for use with automobiles and like vehicles, for indicating the amount of gasoline or other fuel in the tank, and wherein mechanism is provided for permitting a correct reading to be made, regardless of the shape of the tank and amount of fuel in the tank, and wherein the indication is made in liquid measure, and showing the exact amount in such measure at any time instead of indicating the depth of the fuel in the tank.

PNEUMATIC WHEEL.—J. LAUS, JR., 676 Main St., Oshkosh, Wis. In this case the invention is an improvement in pneumatic wheels, and has for its object to provide a wheel of the character specified, having pneu-



PNEUMATIC WHEEL.

matic tires so arranged that all of the resiliency of the tires may be utilized, while at the same time the tires are perfectly protected from injury, and from the actual wear due to contact with the road surface.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

## Eliminating the Coal Range from the Kitchen

(*Concluded from page 64.*)

towns, though in some localities the rate is higher and in some much lower. On this basis, therefore, you can with ordinary devices purchasable at any "electric store," at a cost of one cent for current:

(*a*) Toast ten slices of bread.

(*b*) Make three cups of coffee in an electric percolator.

(*c*) Bring one quart of water to the boiling point.

(*d*) Operate an electric broiler six minutes, an electric griddle eight minutes, a "radiant" grill for ten minutes, or a 4-inch disk stove for twelve minutes.

So much for the cost of operating separate portable devices. With a modern "electric range," however, suitable for a moderate-sized house or apartment, the cost of properly planned meals may be much reduced, bearing in mind the fact that the heat is applied only *where needed* and *when needed*.

Take, for example, the following:

Roast chicken with browned potatoes.
Baked bananas with rice.
Asparagus au gratin.
Blueberry cottage pudding.

This meal, at the rate mentioned, may be cooked in the *oven alone* at a cost of 24 cents, and with fruit, salad and hard sauce for the pudding leaves little to be desired in the way of variety or edibility.

One of the most interesting illustrations of the possibilities in this connection is afforded by ocean-going steamships, and Uncle Sam has not been remiss in "trying out" electric cooking methods in some of his big boats with the most satisfactory results.

A recognized authority says in this connection: "All the handling of fires, of coal and ashes or oil, if done at all, should be done where it belongs, down in the boiler room, not in the galley; and by the stoker, not by the cooks."

Here the question of reliability is of prime importance, and that it has been solved to the satisfaction of the naval authorities is shown by the fact that the U. S. battleship "Texas" recently sailed from New York for southern waters equipped for electric cooking exclusively, the crew consisting of 900 men and 70 officers.

A sample menu for one day is of interest and follows:

*Breakfast:* Baked pork and beans, cornbread, coffee.

*Dinner:* Fried fish, tomato sauce, mashed potatoes, mince pie, bread, coffee.

*Supper:* Clam chowder, cheese, cold slaw, fruit, bread, tea.

Evidently Uncle Sam's boys are not expected to go hungry, as the "fried eggs" item allows for 180 dozen and the bread averages 6,300 pounds per week, exclusive of that supplied the officers' quarters.

Aside from the actual cooking equipment, which has proved most satisfactory, electric dough-mixers, coffee grinders, meat choppers, knife grinders, washing machines, dish driers, etc., are used, and when we realize that the ship is steered, the turrets turned, guns trained, engine-room orders given, ammunition hoisted, the entire ship lighted and a hundred other things done by electricity, we cannot wonder that this is called the "electric age."

## Submarines That Are Strictly Invisible

(*Concluded from page 69.*)

course can be made, if desired, foot by foot, as progress is made, and all mines can be avoided.

The diagrammatic sketches illustrate the Lake method of operation in cutting cables, evading mines, planting counter-mines, clearing away mines or passing under chains, cables, and nets that may be stretched across the entrances of the harbors, to effectively stop the progress of surface vessels and submarines not fitted with bottom wheels.

If the commander of a submarine recognizes that the first principle of successful submarine raiding is to never betray his position by exposing his periscope while under way when within sight of the

LEGAL NOTICES



## INQUIRY COLUMN

READ THIS COLUMN CAREFULLY. You will find inquiries for certain classes of articles numbered in consecutive order. If you manufacture these goods write us at once and we will send you the name and address of the party desiring the information. There is no charge for this service. *In every case it is necessary to give the number of the inquiry.* Where manufacturers do not respond promptly the inquiry *may* be repeated.

MUNN & CO., INC.

*Inquiry No. 9391.* Wanted the name and address of makers of plants for the utilization of by-products from sawdust, also waste wood.

*Inquiry No 9398.* Wanted the name and address of a manufacturer of a machine to print and label lead pencils and pen-holders.

*Inquiry No. 9400.* Wanted to buy an insoluble, non-fusible and opaque plastic material to be used in die moulds for manufacturing tobacco pipes of special kind.

*Inquiry No. 9401.* Wanted the name and address of the owner of a second hand aeroplane motor from 20 to 30 H.P.

*Inquiry No. 9403.* Wanted the name and address of a glass manufacturer who can blow a small glass article to order.

*Inquiry No. 9406.* Wanted the name and address of a manufacturer who can supply insole material in rolls The material seems to be scrap leather composed and attached to a canvas bottom.

*Inquiry No 9407.* Wanted the name and address of some patented mechanical device which saves money or time or both, which if properly handled will bring a large demand. It must not be too expensive. It may be electrical as well as mechanical. A first class article desired.

*Inquiry No. 9408.* Wanted the name and address of a manufacturer or distributor of a machine which will clean both single and double burlap bags; especially heavy bags.

*Inquiry No. 9409.* Wanted to secure a patented device which can be manufactured at small cost and around which a good business could be built.

*Inquiry No. 9396.* Wanted the names and addresses of makers of furnaces for reducing carbonate of barium to oxide, electric or otherwise.

*Inquiry No. 9399.* Wanted the name and address of workers in ornamental polished stone.

*Inquiry No. 9404.* Wanted the name and address of a manufacturer of a tool for cutting nicks in plate glass used for name plates and house numbers.

*Inquiry No. 9405.* Wanted the name and address of a manufacturer who is able to supply an attachable eyelet, aluminum or celluloid through which a snap fastener would work.

*Inquiry No. 9410.* Wanted the name and address of manufacturers of "Scuffer Shoes."

*Inquiry No. 9411.* Wanted the name and address Of a gas lighter using some form of platinum black which ignites by holding over a flow of gas.

*Inquiry No. 9412.* Wanted the name and address of a manufacturer that makes machinery for making bichrome ribbons for typewriters.

*Inquiry No. 9413.* Wanted the name and address of a manufacturer of calendar clips for pencils or pens. Miniature pad tears off same as large calendar pads. Celluloid protecting shield.

*Inquiry No. 9414.* Wanted the name and address of a manufacturer who will make an armchair with an adjustable foot rest.

*Inquiry No. 9393.* Wanted the name and address of someone who has an article which could be made in a large Hickory Handle plant.

*Inquiry No. 9394.* Wanted the names and addresses of firms that deal in machinery for manufacture of plaster of Paris and drying by hot air.

*Inquiry No. 9395.* Wanted names and addresses of manufacturers capable of manufacturing cloth Boards (made of paper, wood, and metal) also sample books. One who is able to turn out unlimited quantities at right prices.

*Inquiry No. 9397.* **Wanted the name and address of a manufacturer of a machine that will automatically dose and fold powders and other preparations.**

enemy, his vessel becomes invulnerable because it is invisible; for no one can attack an unknown, invisible object. The submarine vessel is then invincible because all the science of naval architecture has not thus far been able to devise a protection against the mine and torpedo.

The suggestion has been made that battleships might be kept from destruction by the use of armor placed on the bottom, as well as on the sides of the ship, or that a ship might be minutely subdivided so that she would remain afloat even if torpedoed. Mr. R. H. M. Robinson, who, as a naval constructor in the United States Navy, had charge of the design of all our modern battleships, up to and including the "Pennsylvania," is the authority for the statement that extensive experiments have been made in this country which show that, up to now, it seems impossible to provide adequate protection to a capital ship against torpedoes or mines by either armoring the bottom or subdividing the hull.

## Where the Smoke Helmet Would Be Invaluable

(*Concluded from page 65.*)

air, which includes the smoke and flame, rises, and cool air flows in along the floor to take its place.

In the best and most useful helmets provision is made for a supply of air, to be carried by the wearer, so he can enter and remain in any atmosphere. In some cases a tank of compressed air is carried. In other devices either tanks of oxygen are provided, or an apparatus for generating oxygen. In these cases provision is usually made for removing the carbonic oxide from the breathed air and adding fresh oxygen as required. It has also been proposed to use a tank of liquid air with these helmets. When equipped with helmets supplied with oxygen, it has been found possible for men to remain in the worst atmosphere for five or more hours at a time, and, as has been said above, these outfits have proved successful and indispensable in practical use.

In this connection attention may be called to certain forms of hand fire extinguishers which contain chemicals that liberate dense volumes of chlorine gas which stifle the fire; but this gas is equally effective in stifling life, and is, in addition, a dangerous poison. Whether extinguishers of this kind added to the horrors of the subway fire is not known, but the use of this class of extinguishers in confined spaces where human beings are present would justify action by the criminal courts.

The condition of unpreparedness for such a disaster as exists in New York probably also exists in many other cities, where so-called investigations of smoke helmets are being conducted; but if the officials would apply to the U. S. Bureau of Mines, all necessary information, and that of an impartial and expert character, could be promptly obtained.

## Quack Tree Surgeons

SO many quack tree surgeons and tree repair fakers have sprung up, to the detriment of fine trees that might have been saved by competent treatment, that the Massachusetts Forestry Association has arranged to inspect and advise as to the proper treatment required by any shade trees belonging to its members without charge. Tree surgery requires considerable knowledge and experience and the operations of unskilled parties often result in more harm than help.

## Oil Paint on Cement

THERE is some difficulty in making paint adhere to cement, but if the cement is first washed with 1 per cent sulphuric acid (one part concentrated acid to one hundred of water), rinsed and allowed to dry thoroughly, the paint will find the surface suitably prepared for adhesion. Or the cement may be covered with three coats of water glass (silicate of soda), one part to four of water, and then painted. A first coat of linseed oil varnish followed by the usual paint is effective.

# "A Man Would Die in the First Alcove"

"There are 850,000 volumes in the Imperial Library at Paris," said Emerson. "If a man were to read industriously from dawn to dark for sixty years, he would die in the first alcove."

And he would not die a *well-read man.*

But if a man could know what few great books are enduringly worth while and could read those few—Histories, Biographies, Dramas, works of Travel, Fiction, Poetry, Science, Philosophy and Religion—he would become well read, even though he could devote to them but a few pleasure moments a day.

## *Expert Advice on Your Reading—FREE*

For years Dr. Charles W. Eliot, President Emeritus of Harvard, has maintained that the books really essential to the Twentieth Century idea of a cultivated man could be contained in a Five-Foot Shelf, and from his lifetime of reading, study and teaching—forty years of it at the head of one of the world's greatest Universities—he has put aside those few books that he considers most worth while.

Uniformly bound in fifty volumes, indexed and cross indexed and arranged by Dr. Eliot into fourteen Reading Courses, the set has been brought out at a cost for the preliminary manufacturing work alone of $150,000, as

# THE HARVARD CLASSICS

**The Five-Foot Shelf of Books**

**418 masterpieces at a few cents apiece**

Any man who cares to read efficiently, instead of wastefully, should know what few books Dr. Eliot selected, and why.

He should know why 100,000 successful men are finding in the Five-Foot Shelf just the mental stimulus they need.

Everything you need to know about this famous set of Books is in a *free* booklet. There is a copy for you—no obligation; merely clip the coupon.

S. A.
1-16-15

P.F. Collier & Son, 416 W. 13th St., N. Y. City

Mail me, without obligation on my part, your free "Guide Booklet to Books" containing the story of the Five-Foot Shelf.

..............................................

..............................................

..............................................

# SCIENTIFIC AMERICAN


NIGHT ATTACK BY GERMAN ARMORED MOTOR BOATS IN A FLOODED SECTION OF FLANDERS.

Vol. CXII. No. 4
January 23, 1915

Munn & Co., Inc., Publishers
New York, N. Y.

Price 10 Cents
$3.00 A Year

# SCIENTIFIC AMERICAN

**Founded 1845**

**NEW YORK, SATURDAY, JANUARY 23, 1915**

**Published by Munn & Co., Incorporated. Charles Allen Munn, President; Frederick Converse Beach, Secretary Orson D. Munn, Treasurer all at 361 Broadway, New York**

Entered at the Post Office of New York, N. Y., as Second Class Matter
Entered as Second Class Matter at the Post Office Department, Canada.
Trade Mark Registered in the United States Patent Office



**Subscription Rates**

| | |
|---|---|
| Subscription one year | $3.00 |
| Postage prepaid in United States and possessions. Mexico, Cuba, and Panama | |
| Subscriptions for Foreign Countries, one year, postage prepaid, | 4.50 |
| Subscriptions for Canada, one year, postage prepaid | 3.75 |

**The Scientific American Publications**

| | | |
|---|---|---|
| Scientific American (established 1845) | per year. | $3.00 |
| Scientific American Supplement established 1876. | " " | 5.00 |
| American Homes and Gardens | " " | 3.00 |

The combined subscription rates and rates to foreign countries including Canada, will be furnished upon application
Remit by postal or express money order, bank draft or check

**Munn & Co., Inc., 361 Broadway, New York**

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

*The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.*


## Militarism

MUCH of the muddled-headiness which characterizes the discussion of our public affairs is due to a lack of clear definition of terms. When the most important word in a subject of debate means half-a-dozen different things to half-a-dozen different people, there is little hope of arriving at a common and correct conclusion.

How true this is, in its effect upon the question of the military preparedness of the United States! Here we are confronted with the amazing spectacle of the richest republic in the world in such a state of defenselessness that if its territory should be invaded by any one of the leading military nations, the United States would be powerless to offer any effective resistance.

To what is this perilous condition to be charged? To many causes; but mainly to the confusion which has resulted from the constant reiteration, both in Congress and outside of it, of that scarecrow word "militarism," by people who have no clear sense of its true meaning.

Whenever the experts of our army and navy have urged Congress to make reasonable provision for defending our shores from invasion and crushing the enemy should he effect a landing, they have been met by the cry that this is militarism—something opposed to the constitution, traditions, spirit, wishes, etc., etc., of the United States.

Now what is militarism? Militarism does not consist in the mere possession of an army, big or small. The United States, with a population of about one hundred million people, has within its borders some 30,000 troops or one to every 3,330 inhabitants; therefore, to lay a charge of militarism against this country on the ground of the size of its army would be manifestly ridiculous, and judged on the mere question of numbers it is evident that a considerable increase of our military forces could be made without rendering this country liable to such an implication. Nor is the possession of an army sufficient to prevent an enemy from over-running and ravaging the State and levying heavy tolls, militarism. Thus, Switzerland, with only 3,300,000 inhabitants, can put in the field nearly 300,000 trained soldiers; yet no one has ever made a charge of militarism against that country—the fact being recognized that, because of her important strategic situation and the temptation for powerful neighbors to make a short cut across her territory, Switzerland is fully justified in arming her citizens to protect her neutrality.

What, then, is militarism? For an answer to this question, so clear and convincing that he who runs may read, we direct attention to an article in the New York *Times* on January 12th, 1915, by Prof. Frank Jewett Mather, Jr., of Princeton University, who starts his analysis with a quotation from the New English Dictionary, to the effect that militarism is "the political condition characterized by the predominance of the military class in government or administration; the tendency to regard military efficiency as the paramount interest of the State."

This is an exact definition of the essence of militarism, which, according to Prof. Mather, is simply that the military establishment is not subordinate, but superior to the civic power. The issue is merely, who rules—soldier or statesman? England, according to this authority, is no more militaristic to-day with one and one half million men under arms than she was six months ago with only a tithe of that number, and this for the reason that since the passage of the Bill of Rights, Parliament has always controlled the army and navy. France had her era of militarism under the first Napoleon and under the third; and twice since then, in the Boulanger episode and the Dreyfus affair, she moved in a militaristic direction, but promptly and resolutely retraced her steps toward democratic control.

But when, "at every stage of the delicate negotiations" preceding and inaugurating a war "the military rulers dictate the decision of the civil rulers," the predominance of the military class in government is manifest, and militarism in its extreme form is rampant.

"It may be well," says Prof. Mather, "to ask what are the outward symptoms of militarism in a State. The most evident symptom is an unduly privileged position of its army and navy officers. No English captain of a dreadnought, or French colonel of a legion, or Russian general, or American admiral cultivates or is permitted to cultivate a special set of truculent military manners. He claims no social privileges above other gentlemen. In a controversy with a civilian, the clubs and the law courts give him no favored position. The idea that he is privileged to bully or humiliate the most obscure civilian never occurs to him. In unmilitaristic nations the code, written and unwritten, that is binding on any gentleman is equally binding on an officer."

Now if we apply the above incontrovertible definition of militarism to conditions in the United States, it will be recognized by every American who understands the attitude of our army and navy toward the civil authority and toward the civil population, that militarism has never existed in the United States, has never threatened to intrude on our national life, and is the very last calamity that could befall us.

In no country in the world is there a body of naval and military men, from commander-in-chief down to lieutenant, which is so easy of approach and so courteous in its bearing toward the civilian population as that of the United States. Indeed, the loyal recognition of the predominance of the civil authority is one of the unique characteristics of the military situation in our country. Of all things which we have to fear in America, militarism as described above by Prof. Mather, is the very last.

It follows, then, that to brand as militarism the present nation-wide demand that the neglect of the past be made good by increasing our military forces to the modest strength that will give adequate protection against attack of any power, is not only supremely ridiculous, but is in the highest degree unpatriotic. It is to obscure a vital issue by beclouding it with a term that is not merely misleading but is positively vicious in its effect.

## Science and Lexicography

"IN learning the meaning of scientific terms, the history of science is our dictionary; the steps of scientific induction are our definitions."

Everybody who writes much on scientific subjects must realize the truth of this aphorism of William Whewell; yet few of us can quite free ourselves from our childhood's faith in the Dictionary as a court of last resort, a tribunal without appeal. The present writer recalls the dismay of one of his scientific acquaintances, who was writing a treatise on meteorology, on learning that he had repeatedly used therein the word "insolation" in a sense not at that time recognized by any dictionary of the English language, i. e., as the equivalent of "solar radiation" or "sunshine." The word hardly ever has any other meaning in meteorological literature; yet the accidental omission of the meteorological definition from all the English dictionaries—an accident to which one might still find thousands of parallels—caused our colleague to consider seriously the advisability of substituting another term in his book. It is true that the author in question had given little thought to terminological questions—but one might say as much of at least ninety-nine scientific men in every hundred.

In view of the immense importance of accurate and consistent terminology as an aid, first, to clear thinking, and, second, to the transmission of knowledge, it is a startling fact that very little attention has been paid either to formulating the principles of scientific terminology or to applying these principles to the task of regulating the scientific vocabulary. One must go back more than half a century, to Whewell's almost forgotten "Novum Organon Renovatum," for a sane and comprehensive treatise on this subject.

A hopeful sign, as far as it goes, is the fact that the editors of all the recent great dictionaries published in America have enlisted the aid of specialists in defining scientific terms. The astronomical definitions are written by an astronomer; the chemical definitions by a chemist; and so on. As a result of this plan, technical terms and the technical senses of general terms have received a far greater measure of recognition in general dictionaries than was ever before accorded them; yet the definitions of these terms are often extremely disappointing. It is, unfortunately, a fallacy to assume that an able astronomer is necessarily better qualified than anybody else to write the definitions of astronomical terms. Undoubtedly the ideal lexicographer of astronomy, if he exists, will be found in the ranks of the astronomers; but he will be the exceptional astronomer whose general scholarship and whose familiarity with the history and the literature of his science specially qualify him for lexicographical undertakings. His work in this direction will be, more or less, that of a pioneer; he will find the vocabulary of his science, as used by astronomers themselves, in a state of great confusion; he must know thoroughly the astronomical literature of other languages than his own, since in no language—not even German—is the vocabulary of science free from foreign influences; in short, his scholarship will be taxed to the utmost to ascertain the consensus of usage among his own colleagues, as a preliminary to presenting the definitions of astronomical terms to the public at large. So, *a fortiori*, of many other sciences.

The lexicographer of science should, we believe, be a lexicographer first and a scientist second; but he must be both. Until persons possessing this dual training are more numerous than they are at present, our general dictionaries will continue to be more or less at sea in their scientific definitions—often grotesquely so.

## The Cost of Health-seeking

A "CHANGE of climate" is apt to be looked upon as a panacea for the ills of the flesh, but one that is often difficult or impossible of realization for financial reasons. Nevertheless, we daily hear of cases in which families have achieved the impossible, by dint of heroic labor and sacrifice, in sending invalid members to health resorts to which distance lends the enchantment of hope—sometimes destined to prove altogether illusory. Whether or not the longed-for cure is ultimately effected, climatic treatment is, in the average case, so expensive that its implications should be thoroughly understood by the invalid and his friends before he leaves home, and it is obviously desirable that all physicians should be able to enlighten their patients on this subject.

Dr. Thompson Frazer of Asheville has contributed to the U. S. Public Health Reports a paper entitled "Tuberculosis; the Financial Aspect of the Sick Leaving Home in Search of a Beneficial Climate," in which he calls attention to the fact that tuberculous patients too often fail to realize the futility of visiting a health resort unless provided with sufficient funds to insure suitable living conditions while there and a stay long enough to be beneficial. He says, "A large proportion of people, including the medical profession, seem to be uninformed on this most important phase of the tuberculosis situation"; and he gives some valuable figures as the fruit of his own experience and observation at the well-known North Carolina resort.

As everybody knows, "tuberculosis is the disease of the many, not of the favored few," the vast majority of the sufferers being those who live from hand to mouth and who can so ill afford a suspension of their daily labor that the disease usually reaches an advanced stage—demanding a correspondingly long period of treatment—before they seek a cure that entails inactivity. It is, too, pre-eminently a disease of the earlier years of productive life, with a maximum mortality between the ages of 20 and 30, i. e., it strikes down the wage-earner who has not yet had time to make much, if any, provision for such an emergency.

In estimating the expense of treatment at a health resort several facts are commonly overlooked. In the first place, a short stay is generally useless. Many patients arrive at Asheville nearly insolvent, expecting to be cured in a few weeks, when at least ten months may be requisite. In such cases the money spent in traveling expenses could be used to much better advantage in home treatment. Again, climate is, according to Dr. Frazer, the least important of all the factors that make for improvement in tuberculosis, "and unless supported by the essentials—fresh air, good food, proper care—the most perfect climate must prove valueless." Good food and care are expensive. Economy in these essentials may defeat the object of the visit. Thus, while it may be possible to get a room on the third floor of an Asheville boarding-house, with board, for $8 a week, while a first-floor room costs $10 or $12, the exertion of climbing stairs may be more than the patient can safely undertake. There are various "extras" of which the patient perhaps knows nothing until his arrival. A minimum expense of $700 for a ten months' stay is a fair estimate for Asheville.

In view of the number of people to whom such an expense is either absolutely prohibitive or certain to be a crushing burden upon their families, Dr. Frazer's figures appear to be a powerful argument for a national scheme of health insurance even more far-reaching than that with which Great Britain is now experimenting.

## Electricity

**A National Electric Week.**—At a recent meeting of the representatives of leading electrical manufacturers, central stations, jobbers, contractors, dealers and trade journals, plans were laid for a great national week to be held sometime next fall in the United States and Canada. It is hoped to arouse a great interest in matters electrical, stirring up the public on questions of better lighting for streets, stores, factories, schools and homes and promoting the sale of electrical appliances.

**A Dwarf Telephone.**—At a recent meeting of the Royal Society, London, Dr. P. de Lange, of Utrecht, exhibited a telephone in the form of a small cylinder of about the diameter of a pencil and half an inch long. A very fine wire of platinum is variably heated by the passage of talking currents through it, producing expansions and contractions of the surrounding air and hence throwing out corresponding sound waves. The receiver is small enough to be inserted in the ear and acts as a seal to exclude extraneous noises.

**Electricity v. Steam in Railroad Practice.**—According to the *Electrical World*, a New Haven Railroad official is quoted as saying: "Upkeep of electric engines is on the order of 5 cents to 7 cents per locomotive mile per 100 tons of weight. Steam-locomotive maintenance runs anywhere from 8 cents to 25 cents, depending upon nature of the coal and water used—an average figure of 11 cents would not be bad. With regard to pounds of coal burned for electric-engine v. steam-engine haul, a pound of coal burned under the boilers of a central electric station for such traffic will develop twice the drawbar pull that would be developed if the same pound of coal was burned in the firebox of the steam locomotive."

**Spark Gap Electrodes.**—In order to determine the effect of certain metals on electric sparks, Prof. Daniel M. Rich, of the University of Michigan, has been conducting some very interesting experiments. He has found, by photographic records, that on producing a spark with an alternating current, between a copper electrode and a zinc electrode, a certain number of sparks were given off from the copper electrode, during one half cycle, while in the following half cycle, when the current was reversed, more sparks were given off from the zinc electrode. Prof. Rich believes that the cause of this is that the potential must reach a higher value before it will jump from the copper. Very curiously there was always an even number of sparks from one electrode and an odd number from the other, also the last spark always occurred from the electrode having the higher breakdown value. This surprising effect may be due to the ionizing of the arc, Prof. Rich believes.

**Increasing Self-induction in Cables.**—It is well known that the carrying power of a telephone cable for underground or submarine use is much smaller than that of an overhead line; in other words, a less distance can be covered with clear sound of the voice than for overhead lines, this being due to the preponderance of the capacity of the cable over the self-induction, and the sound of the voice is altered or deadened. An increase in the section of the cable would be expensive, so that other means have been sought in order to reduce the damping effect by an artificial increase in the self-induction. The Danish engineer Krarup makes use of a very successful method which consists in increasing the magnetic permeability in the neighborhood of the conductor by wrapping it about with a very fine soft iron wire, and this has the effect of increasing the self-induction considerably. In this way the carrying power of a cable is generally doubled by the use of the Krarup method. To obtain the same result without the iron wire wrapping, or by simply increasing the section of the copper, four times the section is needed. The Krarup method is a rival of the well-known Pupin system for obtaining the same results.

**French Interurban Network.**—The extensive interurban network of electric power lines in the region of Nancy is of interest not only from a technical standpoint but also from the fact that this part of France lies in the scene of the present war operations. The large town of Nancy is in fact situated not 15 miles from the frontier of Lorraine. An operating company already assured the electric service for the city, and more recently decided to lay out an important interurban system for covering the region lying to the east, south and west of this center. Power comes in part from the city station, but there is a second steam plant building, and it will be situated on the Moselle near Vincey in the Vosges region. Current used is 3-phase at a frequency of 50 cycles, and tension of the interurban network is 65,000 volts standard. At present the output of the city station is about 20,000 kilowatts, while the Vincey plant is to furnish 15,000 kilowatts during the first period of operation and will then be increased to 45,000 kilowatts in the second period. Current coming from the central plants at 11,000 volts over power lines is received in four transformer posts placed at various points in the region, and from these points start the high tension 65,000-volt lines of the network.

## Science

**A Geological Survey of Panama** is in progress under the joint auspices of the Isthmian Canal Commission, the U. S. Geological Survey, and the Smithsonian Institution. The plan includes a systematic study of the physiography, stratigraphy and structural geology, geologic history, geologic correlation, mineral resources (including coal, oil, and other fields), petrography, and paleontology of the Canal Zone, and as much of the adjacent areas of the Isthmian region as it may be feasible to explore.

**Moles** are generally regarded as agricultural pests in this country, and it is therefore interesting to learn that farmers may turn a curse into a blessing by trapping these animals for their skins. At present the moleskins used for making fur garments in the United States are nearly all imported from Europe. The Biological Survey reports that the skin of the common mole of the eastern United States is actually superior to the foreign product. Whether this is also true of the larger species inhabiting the northwestern coast region is the subject of investigations now in progress. The last species is very abundant, as many as a hundred individuals to the acre being found in some localities.

**Mercury as a Plant Germicide.**—A new method of destroying plant and household pests and for fungus diseases has been devised by Mr. Franz X. Bickel of Kufstein in the Tyrol, according to a recent number of the *Chemiker-Zeitung*. In inclosed spaces the mercury is employed in the form of vapor. In other cases it is injected in metallic form directly into the circulating fluids of the plant. The growth of the plant is not only not disturbed, but is in most cases actually assisted. When a tree is treated the process is as follows: With a stout 3-millimeter auger holes are bored in the lower branches—from 5 to 7—in an oblique direction and passing through the pith. These holes are then filled with mercury by means of an ordinary "dropper," after which they are made air-tight with "tree-wax" or some similar substance. From 2 to 7 grammes of mercury are required for an inoculation. The effect is quickly observable and continues for a year or more.

**The Phytopathological Observatory at Turin,** Italy, has just been reorganized, and it therefore seems timely to call attention to this useful institution, which is one of the prominent agencies in the world-wide campaign now being waged against the spread of plant diseases. The observatory was founded in 1908, replacing a phytopathological laboratory established in 1905. According to a royal decree of last May the observatory is now charged with the tasks of (1) following carefully any condition of disease in cultivated plants and studying its causes and remedies; (2) spreading information concerning plant diseases and their treatment among farmers; (3) co-operating with farmers in actual work of suppressing such diseases; (4) phytopathological work in the public parks and avenues of Turin; (5) examination of doubtful mushrooms and other fungi; (6) maintaining a museum of plant pathology; (7) seed inspection; (8) keeping watch for new plant diseases and taking measures to control them throughout Piedmont.

**Smut Fires in Threshing Separators.**—A remarkable series of mysterious and disastrous fires, or so-called explosions, occurred in threshing separators in the great wheat-growing region of eastern Washington last summer. These increased in frequency as the threshing season got under way, until it was no uncommon thing to hear of six or eight fires a day, the total number during the season amounting to at least 300. As each fire necessitated the immediate purchase of a new separator, at a cost of from $1,200 to $1,500, the total loss was very serious, probably half a million dollars, including incidental damages. The fires usually appeared to originate at or just back of the cylinder of the separator, and within two or three seconds the entire separator would be a mass of flames, so hot that it prevented the approach of workmen and very soon destroyed the machine, besides spreading in most cases to the straw pile, the threshed grain, and even the unthreshed grain in the surrounding fields. In several cases workmen were seriously injured by these explosive fires. Although fires in separators had not been previously unknown, they had rarely numbered more than a dozen in a season in the whole wheat region of Washington, Oregon and Idaho; hence the fires of last summer were altogether anomalous, and were widely ascribed to incendiarism. A thorough investigation of the matter was made by experts from the State College of Washington, and its results have just been published. The fires were undoubtedly due to smut, which is exceedingly inflammable. The amount of smut in wheat during the season in question was much above that of previous years. Moreover, the season was remarkably dry; hence the grain and straw had a low content of moisture and was very friable, besides which an unusual amount of static electricity was developed by the cylinders and other parts of the machinery. The report (Bulletin 117 of the Washington Agricultural Experiment Station) suggests various precautions to be taken against such disasters in the future.

## Aeronautics

**Aerial Mail Service.**—Somewhat less space is devoted to this subject in the current annual report of the Postmaster-General than in the report of last year, but it is stated that during the past fiscal year permission was given in eight instances for experimental aerial mail service. An item of $50,000 has been included in the estimates for 1916 for experimental service in this line.

**Accidents to War Aviators.**—An interesting statement is that made by a French publication that the number of deaths of aviators in the war service by accident was very small as compared with the records in time of peace; and the explanation is made that in this service only the most skilled men are engaged, and moreover they do not indulge in the sensational exhibition stunts that have brought disaster to many. It may be noted that it is this same sensational exhibition business that has given the general public many er oneous and misleading ideas about flying machines that will sooner or later prove an injury to aviation.

**Army Aviator Perishes.**—A report from Los Angeles, dated December 21st, tells of a misfortune that overtook two U. S. army officers and resulted in the drowning of one of them. Six machines carrying pilots and observers left San Diego for Los Angeles to compete for the Mackay trophy, scouting for troops on the march near San Diego. The Curtiss aeroplane, driven by Capt. Mueller and carrying Lieut. Gerstner as observer, struck a heavy gale at Ocean Side which forced it far out over the ocean. Although carrying a motor capable of driving at the rate of 75 miles an hour, the Curtiss was dashed into the ocean. Lieut. Gerstner was caught in the upright wires of the machine and carried down to his death. Capt. Mueller clung to the aeroplane, though often drawn under water, and was finally hauled aboard a rowboat by Capt. William L. Patterson, observer on a Burgess tractor, who, with his pilot, Lieut. T. D. Milling, had landed near Ocean Side.

**Gunning for the Air-man.**—The *Echo de Paris* reports an interview with one of the military aviators in which he tells an interesting story of his experience with the sharpshooters of the enemy: "Generally speaking," he said, "when we fly over the enemy's line we run fewer risks than a sharpshooter who leaves his trenches. However, our job has become somewhat more dangerous during the last weeks, for the Germans, whether it be that their shooting has improved or that they now possess a new aeroplane gun, are firing shrapnel which bursts at a height of 2,300 meters. In the early days their shells were ineffective beyond 1,800 meters. Now, at 2,300 meters we are too high to see clearly, so if we want to bring in any useful information we must descend into the zone of fire. Even then our risks do not appear to be very serious, for a day or two ago I found on landing that my machine had been struck by no fewer than fifteen projectiles, but neither I nor my observer were a penny the worse for it."

**Russia has Many Aeroplanes.**—A French authority, who is in touch with the subject, states that, while there are not many private aviators in Russia the milita y authorities of that country have within the last two years trained a very large number of men, and as a result have many more skilled aviators in its service than any other nation. It is also stated that the number has been greatly increased since the war began.

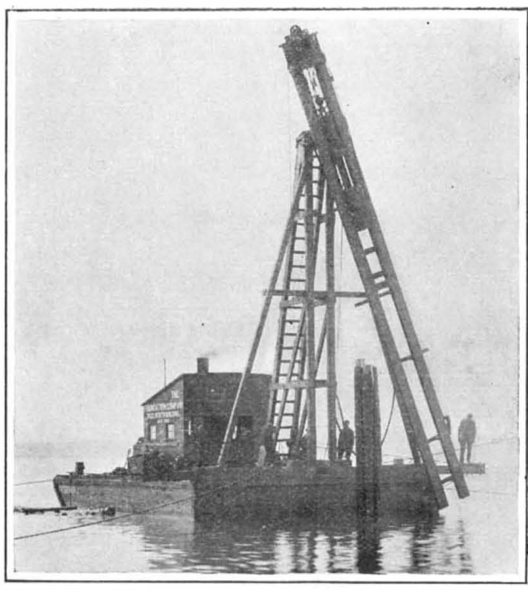
"One talks and reads of the heroic age and how the world has degenerated. But, indeed, this is the heroic age suddenly come again. No legendary feats of the past, no battle with dragons or monstrous beasts, no quest or feat that man has hitherto attempted, can compare with this adventure—this urgently necessary adventure—in terror, danger, and splendor."

Of course one great difficulty stands in the way, and that is the expense, for it is well known that the expenses of taking a title in England are so great as to make it impossible except for a very rich man—and aviators are not of such. But Mr. Wells meets this difficulty with the suggestion: "Is it not a time when honors may again become honorable?"

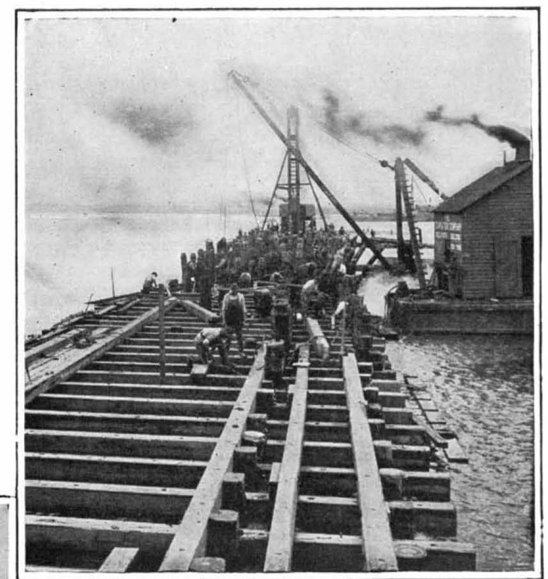
**Aeroplanes for Postal Service.**—At a recent dinner in New York the Second Assistant Postmaster General stated that the United States Post Office Department was considering, and desired to establish postal service by aeroplanes. The district in which this means of carrying the mails would be of special value would be in the Rocky Mountain region, where some towns only a short distance apart by the air line now require a trip of some hundreds of miles by the only available surface routes. Another feature wherein aeroplane service has advantages over other methods is that the going is as good in winter as in summer, a fact that holds good in any part of the country; and the present-day aeroplane can be operated in any but the most boisterous weather. Another consideration would be that in time of war the government would have a large body of splendidly trained men to draw from in the postal aviators, and these men would be not only skilled in handling their machines, but would also have a knowledge of the geography of this country, if their services were needed in home territory.

# Steamship Terminal in the Bronx

## Docking Facilities for Freighters Reaching New York by Way of Long Island Sound. Engineering Difficulties Involved in Damming a Vast Sea of Mud



**Pile-driver for driving batter piles.**



**Capping the bulkhead piles.**


**Composite view illustrating various steps in the building of the bulkhead.**

WERE it not for the menace of Hell Gate, Long Island Sound would long since have become a favored highway for transatlantic as well as coastwise shipping to and from New York. It forms a wonderful harbor, with plenty of deep water for swift navigation, and with its mouth a hundred miles nearer European ports than that of lower New York harbor. Yet steamers from abroad, and even from our own coast, pass by the mouth of the sound, ignoring its sheltered waters, because, before the main docks of New York could be reached, they would have to thread their way through a difficult channel where the East River is almost strangled by Ward's Island. Although the treacherous rocks at this point were long since blasted away, conflicting tides produce cross currents that make navigation well-nigh impossible for large unwieldy vessels.

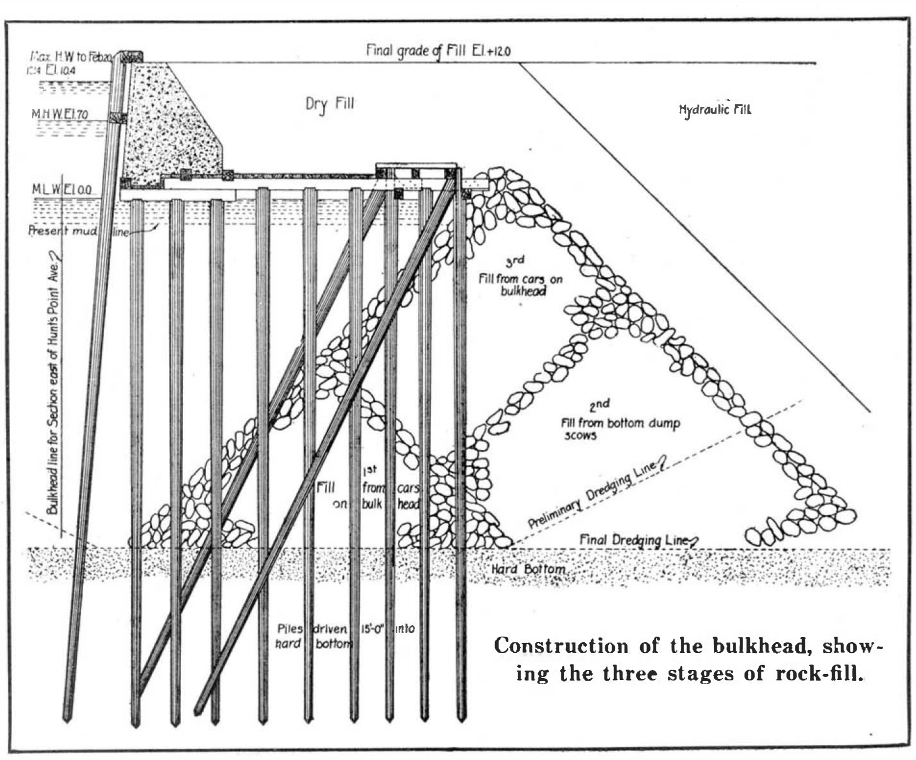
It is idle to dream of bettering conditions there. Not without dislodging Ward's Island itself from the throat of the East River would it be possible for transatlantic vessels to enter New York freely by way of Long Island Sound. Even were such a thing possible it would hardly be advisable to crowd the East River with any more traffic than it now carries. The only thing to do is to provide docking facilities above the obstructed point. It must be apparent that the natural outlet for further development of shipping in New York is to be found along the shores of the Bronx; for here railroad connection can be had readily with the network of New England lines, and also with lines running through New York State and to the West, while the connecting railroad which is now being built over Hell Gate to connect New England with Long Island, and then, by tunnel under the East and North Rivers, with lines running south and west, makes this a strategic point for freight traffic with every part of the country.

Hitherto developments in the Bronx have been retarded by an unfavorable shore line, consisting of a vaguely defined region of salt marshes, with a vast and deep mudbank stretching out for hundreds of feet to the channel. Now, however, despite the engineering difficulties presented by the mud, work is under way to provide a large terminal at Hunt's Point. This is just above Hell Gate, and close to the imaginary line dividing the East River from Long Island Sound. The accompanying map indicates the position of the point with respect to Manhattan Island, and the property acquired by the terminal company is delineated in the enlarged map of the region.

Hunt's Point proper is a rocky projection reaching out well toward the channel. On either side of it and also from the Point itself, the mud stretches out toward the channel with a very gradual gradient. Two bulkheads are being built, one at each side of the Point, well within the pierhead line, and dikes of rocks are being laid from the ends of these bulkheads along the boundaries of the property back to the mainland. The entire property will be filled up to a level of about twelve feet above mean low water, while the mud between the bulkheads and the channel is to be dredged out.

It is no simple task to confine a large and deep body of mud of such fluid consistency as is encountered at this point. The construction of the bulkheads called for a special method, which is illustrated in our wash drawing and also in one of the line drawings. First a preliminary channel was dredged along the line of the bulkhead down to hard bottom. This involved the removal of an enormous amount of mud owing to the flat angle of repose of the thin fluid mud. So fluid was the mud that it could not be removed with the ordinary bucket dredge, but had to be excavated with a hydraulic dredge. Inland, the marshy meadows were inclosed with dikes made of sod and surface material, and within these confining dikes the mud was deposited by a hydraulic dredge. On the east side of the Point the mud varies from twenty to forty-five feet below low water, and on the west as much as sixty-five feet in some places. Curiously enough, after the mud had been dredged out, the hard bottom proved to be at a higher elevation than before; that is, if a sounding had shown a depth of forty feet, after the excavation it was found to be thirty-seven feet. This curious condition was due to the boulders which apparently were actually floating in the mud. As they were not removed by the hydraulic dredge, they collected in a layer on the bottom.

After the preliminary channel had been dredged, piles were driven into the hard bottom through these boulders. The piles were driven in rows of ten with a pair of batter piles to each row to take the thrust of the fill back of the bulkheads. The batter piles were driven by means of a pile driver with swinging leads. A photograph of this pile driver is reproduced herewith. Owing to the layer of rock on the bottom, the piles presented a very disordered jumble at the top. They had to be marked and sorted out to bring them into proper alignment to be capped.




**Construction of the bulkhead, showing the three stages of rock-fill.**

After they had been capped rock was deposited about them in the position indicated in our drawing. The rock was deposited in three piles, the first pile being dumped from cars running on the bulkheads. After this had settled a second pile was deposited from bottom-dump scows and allowed to settle to hard bottom. Finally, the third pile was dumped from cars on the bulkheads, filling the space between the first and second piles and reaching to the top of the bulkheads.

At the present writing the work on the east bulkhead has been completed up to the point of building the concrete quay-wall on the deck carried by the piles. Barges of city refuse are being towed in behind the bulkhead and the material is being deposited upon the rock fill to seal up all the crevices through which the mud might filter. After the dry fill has been completed mud will be excavated from before the bulkheads and deposited behind them, until the level has been raised to the final grade indicated on the drawing.

The work on the dikes stretching from the land out to the bulkheads, along the margins of the company's property is rather interesting. Trestles were built by driving piles down to hard bottom, and, on these trestles cars of rock excavated from the new subway work in the vicinity, were run out and dumped into the mud. At first the rock would be held in suspension in the mud, but as more was added, it would eventually sink to the bottom. In doing so, however, it produced mud waves which were constantly wrecking the trestle.

Frequently a large part of the trestle would disappear with the pile of rock that had been dumped from it. As the rock settled to the bottom there would be subsidence in the surface of the mud at that point which would be compensated by an elevation at some other point. The action was very similar to that of a wave of water, but infinitely slower. As the mud was pushed up by the rock that displaced it, it would curl over slowly like a breaker. One of our photographs shows this interesting phenomenon. All that could be done was to continue depositing new material and rebuilding the trestle until eventually a pile of rock was established from the solid bottom below to a level above that of the surrounding mud-flats.

The bulkheads are well within the pierhead line. On the east side there will be room enough to build piers a thousand feet long. The channel provides a depth of thirty feet below mean low water, so that large vessels may be accommodated. The terminal should not only attract new traffic through Long Island Sound, but should divert to itself much of the shipping that now is obliged to pass on down the narrow congested East River. It should do much for the development of the upper part of greater New York, which is the logical outlet for further expansion of this great city. We are indebted to the Foundation Company which is building the bulkheads for the photographs here reproduced.

**A mud-wave slowly curling over like a breaker.**

**Sod dike for retaining the hydraulic fill.**

## American Samoa

THE Navy Department has recently published a pamphlet entitled "American Samoa; General Report of the Governor," which constitutes a unique reference-book concerning this small and heretofore little-known American possession in the South Seas. The author is Commander W. M. Crose, U. S. N., who formerly occupied the triple post of governor of the colony, commandant of the Tutuila Naval Station, and commander of the station ship. The report comprises a history of the islands; a description of their physical geography, flora, and fauna; a summary of the laws and other political features; and general statistics. Among the more novel and striking facts set forth in this publication are the following:

The islands have no regular laws, but are subject to "regulations" issued by the governor. The political status of the islands and their inhabitants is peculiar. Although, after much diplomatic see-sawing, England and Germany renounced all claim to the portion of the Samoan group now constituting American Samoa, and the rest of the group is now a German crown colony (or was, prior to the recent raids by Australian cruisers), the United States did not, by virtue of the international agreement, acquire sovereignty over the islands, the independence of which had previously been recognized by the three powers. The chiefs of Tutuila formally ceded their island to the United States in 1900, and in 1904 the authority of this country was recognized by the chiefs of Manua; but although these cessions were accepted by the President, they have never been acted upon by Congress. The political relations of the territory have been fixed chiefly by decisions of certain departments of our Government. Thus Samoans are not citizens of the United States, but they owe allegiance to the flag; vessels owned by Samoans are not entitled to registry, but are nevertheless entitled to fly the flag; while goods imported from the United States pay the same customs duties as those from foreign countries.

Pago Pago, the only port of entry, has the best and safest harbor in the South Seas, formed in the crater of an immense volcano, the south side of which is broken away and open to the sea.

A monthly newspaper, *O le Fa'atonu*, is the government gazette, containing all new regulations and instructions, besides information of general interest.

The leading product and only export of the islands is copra, all of which is marketed for the natives by the government. Blank bids are sent to copra buyers in all parts of the world, the bids received being opened the first of March. The contract is awarded to the highest bidder, if approved by the governor, the contract covering the product of all plantations of Tutuila and Manua for the calendar year. Native taxes are also paid in copra.

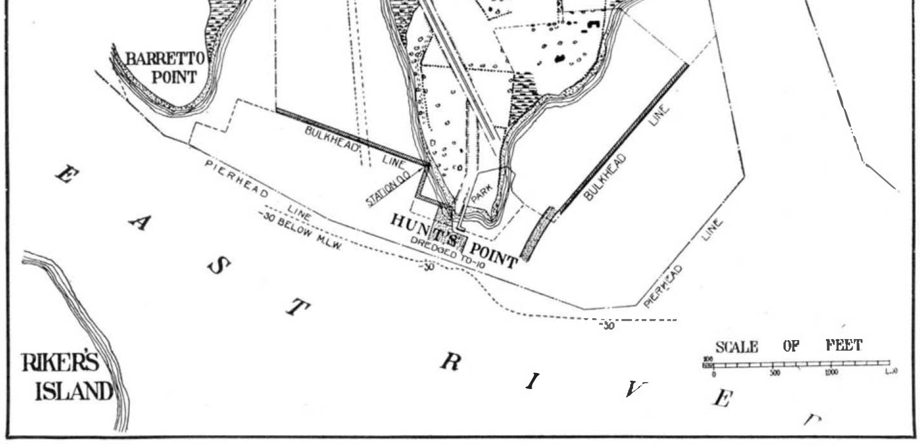
All the natives are Christians and intensely religious. They all go to church, and there are family prayers morning and evening in every Samoan home, while Sunday is scrupulously observed as a day of rest. Practically all the schools in the colony are under the direction of the missionaries, and are conducted by the native pastors of the various denominations. The textbooks are printed in the Samoan language. A number of young Samoans have been sent to Hawaii for higher study, under pledge to return to Samoa and become instructors of their own people.

Although American naval officers hold the principal offices at the seat of government, the provincial and local offices are held by native chiefs. Village chiefs are elected annually. Delegates from all parts of the island are sent annually to a general assembly, the "fono," at which the public affairs of the colony are discussed, though the meeting has no authority to make laws. As to native customs, tattooing is universally practised on men, and frequently on women, despite the efforts of the missionaries and authorities to discourage it. The operation is painful, and the subject is usually laid up for several days following the tattooing, which itself takes three or four days.

The population has decidedly increased under the American *régime*, and was 7,251 in 1912.

---

**Agriculture in Porto Rico** is undergoing important changes, under the direction of the local agricultural experiment station, these changes being in the lines of (1) diversification, and (2) adjustment to changed economic conditions. Much of the capital formerly invested in extensive sugar plantations has now been diverted to fruit growing, which in a dozen years has increased in exports from a few thousand dollars to several million. The experiment station is conducting a survey of the island to determine which sections are best adapted to fruit growing, and experiments for improving the fruit industry in every way are being carried on. Special attention is also given to the growing of the coconut and other tropical nuts and improved varieties of mango.




**Map of the terminal site, showing the positions of the bulkheads.**


**Map showing position of the Hunt's Point terminal.**

# Morning and Evening Stars for 1915

## Annual Progress of the Planets in Their Orbits

By Prof. Frederic R. Honey, Trinity College

THE year 1915 presents to the observer of "morning and evening stars" its own peculiar features of interest in planetary current events. Among the most conspicuous of these is Saturn's favorable position for observation, the planet reaching perihelion on February 21st. Jupiter's approach to perihelion steadily increases his brilliancy; while Mars, the war god, draws constantly nearer to us until he reaches his maximum proximity early in 1916.

### The Sun.

The Sun is a star of enormous magnitude as compared with the planets whose motions it controls. Its diameter (864,367 miles) is more than 109 times the Earth's diameter and 1,300,000 times its volume. Its axis, which is directed to a point in the heavens midway between Vega and Polaris, is inclined at an angle of 82.75 degrees to the plane of the Ecliptic; i. e., the angle of inclination of the Equator is 7.25 degrees. The Sun's rotation in 25¼ days is proved by the periodic appearance and disappearance of Sun spots, which, in the months of June and December, when the Earth is in the plane of the Sun's Equator, appear to move in straight paths. In March and September their apparent motions are in curved paths. On account of the Earth's movement in its orbit in the same direction as the Sun's rotation—shown by the arrows $A$ in the accompanying plots—the Sun *appears* to rotate in 27¼ days, the synodic period.

### The Planets.

The volumes of the planets are very unevenly distributed, Jupiter and Saturn absorbing nearly 94 per cent, and Uranus and Neptune together about 6 per cent of the whole, leaving a fraction of 1 per cent for the Terrestrial Planets. In plots of these dimensions the projection of an orbit on the plane of the Ecliptic practically represents its true form. The table gives the mean distance from each planet to the Sun in terms of the Earth's mean distance (= 92,894,767 miles); its period in years; its velocity in miles per second; the eccentricity of the orbit; and the inclination of the orbit to the plane of the Ecliptic. The intersection of the plane of a planet's orbit passing through the Sun is the line of nodes. It is shown in Mercury's orbit, but in order to avoid confusion only a small part of it is represented in each of the orbits of the other planets. This page may be regarded as the plane of the Ecliptic, and the point $N$ where the planet passes from one side of the Ecliptic to the other side, is the ascending node; $N'$ is the descending node, and $P$ is perihelion or point of nearest approach to the Sun. The positions of the Terrestrial Planets are shown at intervals of four days, and on account of Mercury's very rapid change in velocity, the positions are given at intervals of two days. In the plots of the orbits of the Terrestrial Planets the positions of Uranus and Neptune are indicated at the dates of opposition and conjunction, and those of Jupiter and Saturn at intervals of 45 and 60 days, respectively. In the plot of the orbits of the Major Planets the positions are given for January 2nd and December 28th. A comparison of the orbit of Mars in the plots will show the great difference of the scales of the drawings. Together they exhibit the continuity of the Solar System.

TABLE I.
SOME ELEMENTS OF THE PLANETARY ORBITS.

| Planet | Mean Distance | Period Years | Velocity miles per Second | Eccentricity | Inclination to Ecliptic |
|---|---|---|---|---|---|
| Mercury..... | 0.387 | 0.241 | 23—35 | 0.206 | 7.00° |
| Venus....... | 0.723 | 0.615 | 21.9 | 0.007 | 3.39 |
| Earth....... | 1.000 | 1.000 | 18.5 | 0.017 | .......... |
| Mars........ | 1.524 | 1.881 | 15.0 | 0.093 | 1.85 |
| Jupiter..... | 5.203 | 11.862 | 8.1 | 0.048 | 1.31 |
| Saturn...... | 9.539 | 29.458 | 6.0 | 0.056 | 2.49 |
| Uranus...... | 19.191 | 84.015 | 4.2 | 0.047 | 0.77 |
| Neptune..... | 30.071 | 164.788 | 3.4 | 0.009 | 1.78 |

### The Earth.

Our planet is an oblate spheroid whose equatorial diameter is 7,926.68 miles and polar diameter very nearly 7,900 miles. The Earth's axis, which is directed to a point in the heavens about 1¼ degrees from Polaris, is inclined at an angle of 66.55 degrees to the plane of the Ecliptic; i. e., the inclination of the Equator is 23.45 degrees. The Earth rotates in the direction of the arrow shown at the date January 2nd in the plot of the orbits of the Terrestrial Planets. Each day the Earth moves a distance of nearly 1,600,000 miles; this measurement on the orbit subtends at the Sun an angle on the average of a little less than one degree $\left(=\frac{360°}{365.25}\right)$. Since the eccentricity is 1/60 the distance from the Sun to $C$, the center of the orbit ($= e$) is a little over one and a half million miles, i. e., the Earth is more than three million miles nearer the Sun in January than in July.

### Mercury.

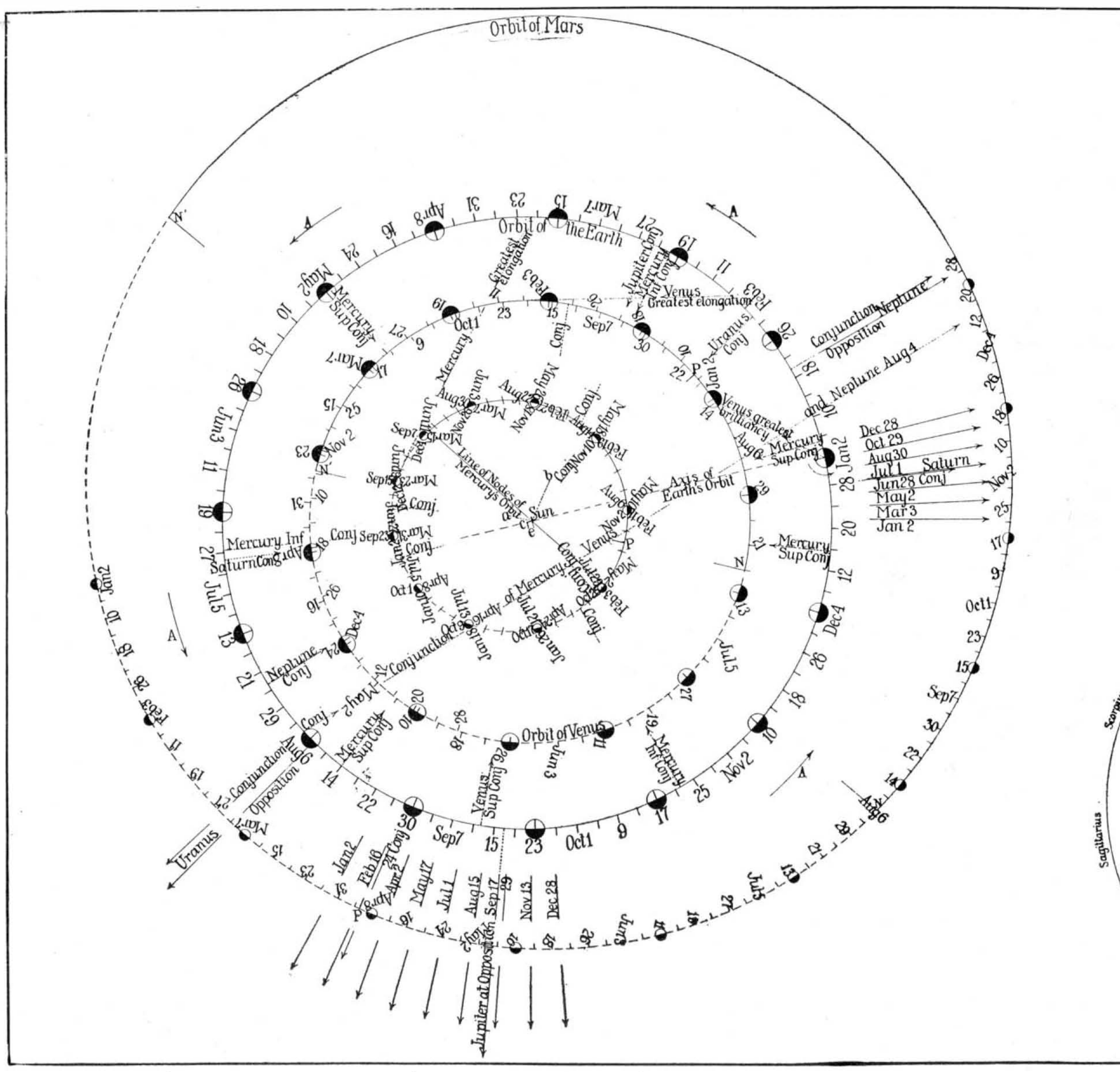
Mercury's diameter is 3,008.5 miles, and the volume is one eighteenth that of the Earth. On account of the great eccentricity of the orbit whose center is at $a$, the planet's velocity varies between 35 miles per second at perihelion and 23 miles at aphelion during its period of nearly eighty-eight days. Since Mercury makes more than four revolutions in the year, four dates are attached to each position. The date of greatest elongation will be March 20th (Fig. 1), when Mercury will be morning star and near aphelion. Other dates of great elongation are February 5th (evening star), May 31st (evening star), July 18th (morning star), September 27th (evening star), and November 6th (morning star). By an inspection of the plot the reader will easily decide upon the dates when Mercury will be seen to best advantage, i. e., when the planet will be farthest from the Sun. Mercury will be nearest the Earth on June 25th (invisible) and farthest from the Earth on December 14th. Fig. 1 illustrates the variations in the apparent diameter of the planet during the year.

### Venus.

The diameter of the planet is 7,701 miles and its volume is more than nine tenths the Earth's volume. Owing to the small eccentricity of the orbit, its center can scarcely be distinguished from the Sun in a plot of these dimensions. The period of the planet is 224.7 days, which means that Venus makes more than one and a half revolutions in the year. The dates for the first revolution are affixed without the orbit; those for the second revolution within the orbit. Fig. 2 (January 2nd) shows Venus at the date of greatest brilliancy—the beautiful crescent phase, which occurs five weeks before and after inferior conjunction. February 6th is the date of greatest elongation and September 12th that of superior conjunction. The drawing gives the apparent diameter at the date of conjunction, if the Sun were out of the way.

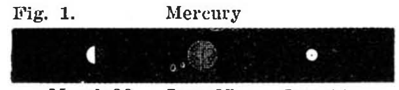
### Mars.

Mars's diameter is 4,549 miles and its volume is one fifth the volume of the Earth. While the eccentricity of Mercury's orbit is greater than that of any of the



Orbits of the terrestrial planets for 1915.

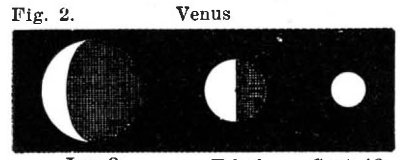
Fig. 1. Mercury



March 20 June 25 Dec. 14

**Variations in the apparent diameter of Mercury.**

Fig. 2. Venus



Jan. 2 Feb. 6 Sept. 12

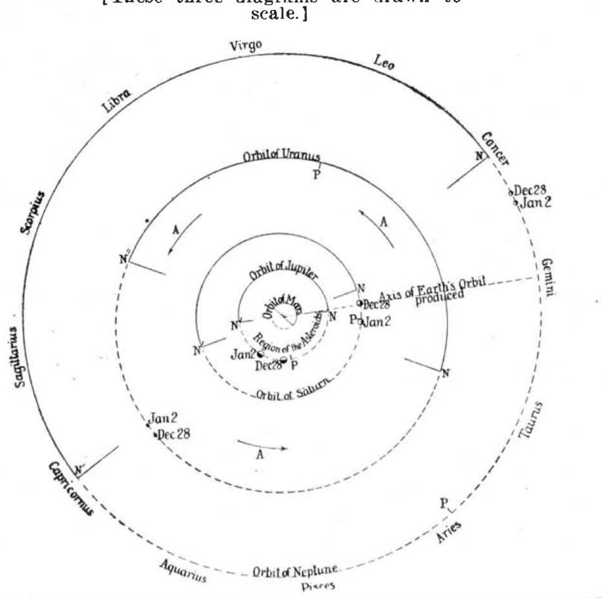
**Venus at greatest brilliancy.**

Fig. 3. Mars.

Jan. 2 July 1 Dec. 28

**Increase in apparent diameter of Mars as it approaches the Earth.**

[These three diagrams are drawn to scale.]




Orbits of the major planets for 1915.

Terrestrial Planets, the linear eccentricity or actual distance from the Sun to *b*, the center of the orbit of Mars, is the greatest. Mars will make his perihelion passage on April 5th. The rapid increase in its apparent diameter as the Earth draws nearer to the planet is illustrated in Fig. 3. The next opposition will occur on February 9th, 1916. Figs. 1, 2, and 3 are drawn to the same scale.

#### Jupiter and Saturn.

Jupiter's equatorial diameter is 90,254 miles and the polar diameter is 84,778 miles, making the volume 1,390 times the Earth's volume. The great brilliancy of the planet is enhanced by approaching perihelion, and Jupiter at opposition (September 17th) will be in excellent position for observation, when the planet's apparent diameter will approach its maximum.

The equatorial diameter of Saturn is 76,455 miles and the polar diameter 69,780 miles. Its volume is 820 times the Earth's volume. Saturn will be at perihelion on February 21st, and thus in excellent position for observation of the rings, at the beginning and the end of the year. The under or southern surface of the rings can now be observed advantageously. The next opposition will occur on January 4th, 1916.

#### Uranus and Neptune.

The diameters of Uranus and Neptune are, respectively, 30,193 and 34,823 miles, and their volumes are, respectively, 55 and 85 times the volume of the Earth. The linear eccentricity of the orbit of Uranus is the greatest in the Solar System. Its center is nearly 84,000,000 miles from the Sun. The corresponding measurement in the orbit of the more distant planet is less than 24,000,000 miles.

The dates of oppositions and conjunctions are given in Table II, and of conjunctions of the planets in Table III. One illustration of the latter is given in the drawing, viz., three conjunctions of Mercury, Venus, and Neptune, which occur on August 4th.

#### Morning and Evening Stars.

Morning and evening stars for any assigned date are easily determined by placing the plot of the Terrestrial Planets in a position where the Earth is between the reader and the Sun; thus the dates can be seen without turning the head. A straight edge through the Earth and the Sun will divide the planets into two groups—those on the right, which rise before the Sun and are morning stars; and those on the left, which set after the Sun and are evening stars. Between inferior and superior conjunctions Mercury and Venus are morning stars, and between superior and inferior conjunctions they are evening stars. Before conjunction the other planets are evening stars; after conjunction they are morning stars.

TABLE II—GREENWICH TIME.
CONJUNCTIONS AND OPPOSITIONS.

| Date | Conjunction | Opposition |
|---|---|---|
| January 5th... | Mercury (superior).......... | |
| January 19th... | ........................ | Neptune. |
| February 1st.. | Uranus..................... | |
| February 21st.. | Mercury (inferior).......... | |
| February 24th.. | Jupiter.................... | |
| May 1st...... | Mercury (superior).......... | |
| June 26th...... | Mercury (inferior).......... | |
| June 28th...... | Saturn..................... | |
| July 23rd...... | Neptune.................... | |
| August 6th.... | ........................ | Uranus. |
| August 13th.... | Mercury (superior).......... | |
| September 12th. | Venus (superior)............ | |
| September 17th. | ........................ | Jupiter. |
| October 22nd... | Mercury (inferior).......... | |
| December 15th. | Mercury (superior).......... | |

TABLE III.
CONJUNCTIONS OF THE PLANETS.

| Date | Planets |
|---|---|
| January 1st.................... | Mercury and Mars. |
| January 20th.................... | Mercury and Uranus. |
| February 1st.................... | Mercury and Jupiter. |
| February 14th.................... | Mars and Uranus. |
| February 18th.................... | Mercury and Jupiter. |
| February 28th.................... | Mercury and Mars. |
| March 18th.................... | Venus and Uranus. |
| March 23rd.................... | Mars and Jupiter. |
| March 29th.................... | Mercury and Jupiter. |
| April 3rd.................... | Mercury and Mars. |
| April 15th.................... | Venus and Jupiter. |
| May 14th.................... | Venus and Mars. |
| May 31st.................... | Mercury and Saturn. |
| June 24th.................... | Mercury and Saturn. |
| July 10th.................... | Mercury and Venus. |
| July 17th.................... | Venus and Saturn. |
| July 22nd.................... | Mercury and Saturn. |
| August 4th.................... | Mercury and Venus. |
| August 4th.................... | MercuryandNeptune. |
| August 4th.................... | Venus and Neptune. |
| September 10th.................... | Mars and Saturn. |
| October 11th.................... | Mars and Neptune. |
| October 17th.................... | Mercury and Venus. |

## Extinguishing a Candle

AN ingenious method of extinguishing a candle when it burns down to a certain point is worked as follows: Tie a string around the candle at the desired point, then take the string through the usual loop support or ring at the base of the candlestick, then pass it up to a pair of pulleys on ceiling or wall, bring down the end of the cord just above the candle and tie on a light extinguisher, which thus hangs over the candle. Nails or hooks can be used instead of pulleys for the cord. When the candle burns down to the string, this is detached and lets the extinguisher drop upon the candle. The device should, of course, be tried to make sure that the cord works easily in the different supports.

# Correspondence

*[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]*

## Directed Fog Signals

To the Editor of the SCIENTIFIC AMERICAN:

The letter from Mr. R. F. Blake in your issue of December 19th recalls an old idea of mine. I have often wondered at its not being used by all vessels having steam whistles. It is, to have a brass megaphone over the whistle so that the sound would go directly forward. Of course the sound would go farther and in a more direct line. When a number of vessels are in a fog, as it is now, the sound waves going out in circles from each whistle, makes it difficult to tell in what direction the vessel is moving. The megaphone, to my mind, would be very inexpensive and of much service in determining the approach of a ship.

FRED. BRADLEE ABBOT.

Bradlee Farm, Sharon, Mass.

## Left-hand v. Right-hand Drive

To the Editor of the SCIENTIFIC AMERICAN:

The writer, who has been one of your interested readers and subscribers for a great number of years, was much interested in an article under the heading of "Automobile Notes" in your issue of November 28th, in which you stated that there was noticed recently a tendency to "hog the road" by the drivers of motorcars having a left-hand drive, and it recalled to my mind that this same statement was made to me by a salesman of a car still using right-hand drive at a recent automobile show, so that it is evident that such a notion has been sent broadcast by the sales force of these cars as an argument against the left-hand drive in favor of their continued use of the out-of-date right-hand drive, and it seems odd that you should be misled by such a peculiar argument.

The writer has driven right-hand drive cars for a great number of years and more recently left-hand drive altogether; and since the statement as quoted above was made to him some two months ago, he has made note on the road of the disposition of both right and left-hand drive car operators to find out whether or not there was any basis for such an argument, and after this observation he is convinced that this situation exists solely in the minds of certain salesmen as a selling argument in favor of an acknowledged out-of-date driving position.

I have noticed there is much, if not more, disposition of left-hand drive car operators to give you half or more of the road than right-hand drive car operators, and I feel sure that it is due entirely to the fact that the driver on the left-hand side can judge very much better exactly how much room he is giving the other driver coming toward him because of his much better position on the passing side of his car, and from my driving experience in the last two years with a left-hand drive car I can frankly say that it is the equal in every way of the right drive position on any of the roads that I have encountered in some twenty to twenty-five thousand miles driving during this time.

Dayton, Ohio. C. C. BLACKMORE.

## The Mississippi River Problem

To the Editor of the SCIENTIFIC AMERICAN:

Capt. Beauregard Roberts, a man of much experience on our local rivers, said to me the other day that he believed the way to handle the Mississippi River problem was to pump the sand bars out of the river with centrifugal pumps. He said that the sand picked up by the current from eroding banks was carried to the next eddy and deposited, eventually forming a sandbar. The sandbar deflected the current, making the river narrower and causing a faster current. The current at Mobile was slower since the dredging out of the river in front of the city, he said, and while in former years at times of flood they experienced much trouble in towing, now they had no trouble whatever. Logs in rafts would sometimes stand on end, showing in this manner the peculiar character of the current caused by the uneven character of the bottom of the river. It seems to me that Capt. Roberts is correct in his view. Inasmuch as the current of the Mississippi as confined by the levee system does not scour out the river in its bed and take the mud out into the Gulf below New Orleans, but the silt and alluvial soil from above form bars along its course and raise the bed, the constantly increasing deposits must be removed by artificial means, unless the levee system is abandoned and the river left to flood and deposit its silt on the banks.

As it is improbable that the levee system will be abandoned at its present stage, it seems to me that it would be a wise idea to use the released centrifugal dredges recently used in dredging the Panama Canal on the Mississippi River, working up from New Orleans, and gradually removing the sandbars and causing a uniform flow of the water across the whole bed of the river, relieving rapidly the pressure from the flooding above. The sand pumped out of the river could be massed along the front or back of the levees, making an impenetrable rampart to withstand the pressure of the water in the river when it reached the levees. The removal of the sandbars at the same time would prevent, to a large measure, the deflecting of the current against the banks and save them from caving. The bends themselves, which in some measure are responsible for the deflection of the currents, could eventually be removed, the centrifugal dredge eating through the soft soil rapidly, making a small canal, and the water doing the rest. The sandbars, no doubt, are responsible to a large measure for these bends, the current going around them and the bars constantly building out. The deflection of a current by any means to one side of the river will cause the bank to cave on that side and cause an eddy on the other, the silt in the eddy being deposited and forming a sandbar. As the building of a levee by a centrifugal dredge certainly would be far less expensive than the mule shovel system, the river being dredged out at the same time, it seems to me that the levee boards along the Mississippi River would be glad to aid the Government in paying the expenses of operating the dredges.

Mobile, Ala. GEORGE B. CLEVELAND, JR.

## Light from Electricians' Black Tape

To the Editor of the SCIENTIFIC AMERICAN:

Unfamiliar facts about very familiar things are constantly being discovered. In the writer's experience, a case of this kind which seems to have heretofore escaped observation, or at least publication, is that of the light sometimes emitted from ordinary electricians' black tape or tire tape. If the tape be quickly stripped from the roll, a line of green light will be noticed at the point where the tape leaves the roll. This light is of sufficient intensity to be seen when the eyes are accustomed to mild diffused daylight. If the tape be rolled up again very tightly and allowed to remain thus for some time a less intense light may sometimes be observed on again stripping off the tape, though this second development of light cannot be depended upon. Surgeon's adhesive tape acts similarly, though the light is not so bright.

The cause of the phenomenon is as yet unknown; static electricity, chemiluminescence and triboluminescence have all been suggested, the last appearing to be somewhat the more probable.

Pittsburgh, Pa. F. ALEX. MCDERMOTT.

## Loss of the "Bulwark"

To the Editor of the SCIENTIFIC AMERICAN:

Your article of December 12th, 1914, on the loss of the pre-dreadnought "Bulwark":

This ship had four 18-inch torpedo tubes. Is it not more likely that some fumbling with the war-head of a torpedo blew her up, rather than an accident with the ordinary ammunition? M. I. MECH. E.

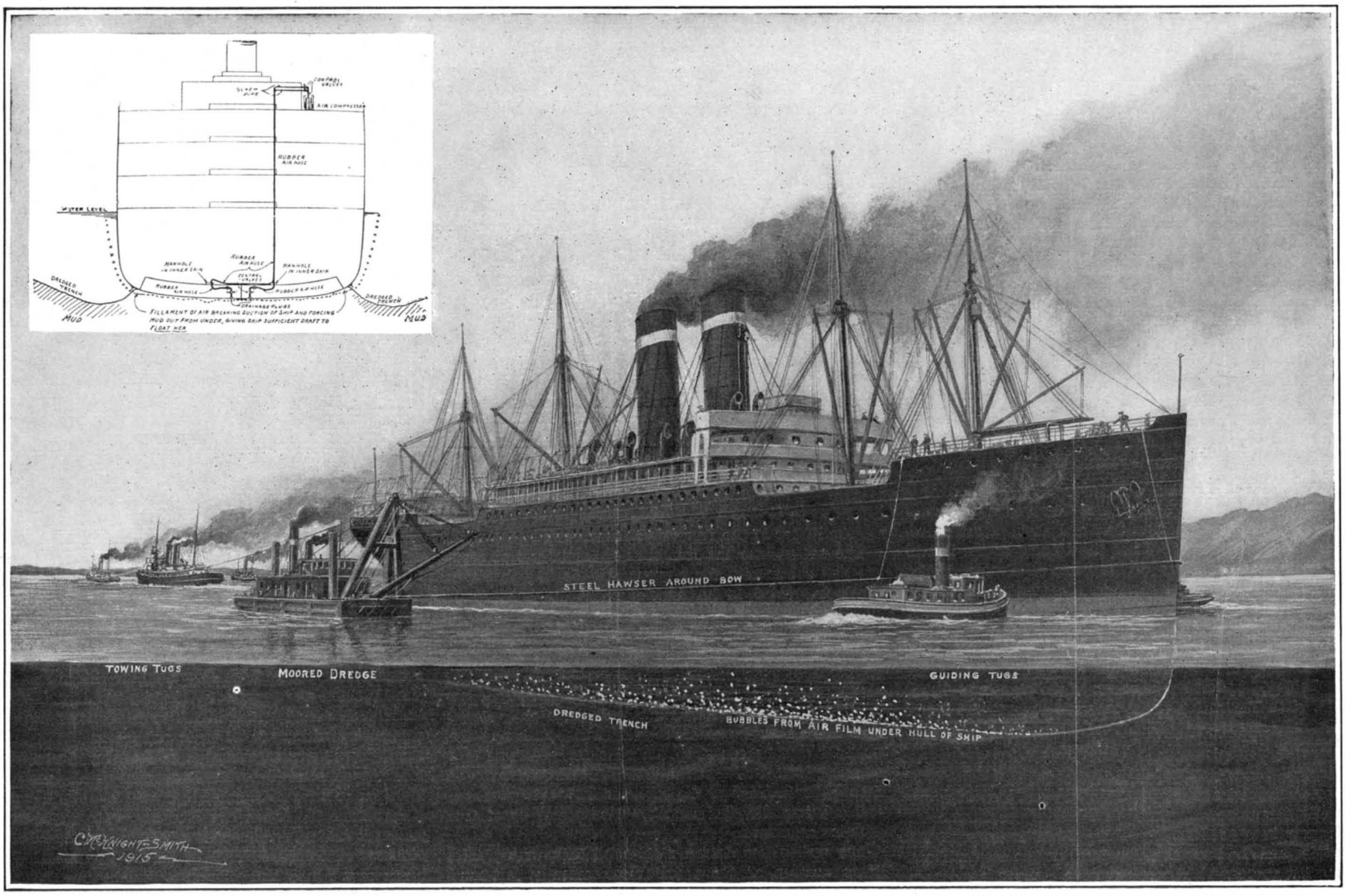
London, England.

## A Safety Code for Abrasive Wheels

KNOWING that the majority of the accidents that occur in the use of grinding machines are the result of ignorance of some of the factors essential to safety, and that this lack of appreciation and understanding of proper conditions extends to insurance engineers, State factory inspectors, and officials of labor departments, the abrasive wheel manufacturers appointed a committee to draw up a code for the safe use and care of abrasive wheels and the parts of grinding machines relating thereto. This code had in view not only the supplying to users of grinding machinery and abrasive wheels with complete information and instructions for the safe operation of this class of tools, and to prevent unsafe practices in the future, but is intended to be used as the basis for a campaign for uniform State laws and uniform insurance rules.

This code covers every detail relating to the operating of grinding machinery, including specifications of the proper sizes of wheels and spindles to be used, proper running speeds, sizes and kinds of fittings, and the correct manner of fitting wheels, protection hoods, testing wheels, and all technical details necessary for their safe operation. It is hardly necessary to add that a carefully prepared code of instructions, prepared by competent experts, such as this, is of economical value to all users of this class of machines, as it enables them to secure increased efficiency and avoid delays.

The code prepared by the committee above referred to has been subscribed to and adopted by almost every manufacturer of abrasive wheels in this country and Canada, and it has also been approved by the National Machine Tool Builders' Association.




**When the "Zeeland" went ashore during a fog she ran into the mud nearly three feet above her usual light load line. A channel was dredged, but the mud beneath her could not be reached. The salvors loosened the ship by forcing compressed air beneath the bottom.**

# Floating a Stranded Ship on Air

## Refloating the Steamship "Zeeland"

By Robert G. Skerrett

THE famous prophecies of Mother Shipton included, among other things, that the day would come when ships would float upon air, and she probably foresaw the giant Zeppelins. Recently, however, a liner of more than 11,000 tons has been supported by a mere film of air! In fact, this old English prophetess has thus been many times outdone.

On Friday, the 13th of November last, the steamship "Zeeland," bound up the St. Lawrence for Montreal, went ashore during a fog. She was running so fast that she forced herself upon the mud nearly three feet above her usual light load line. The liner was trying to make haste to take on cargo and be off for England with the least possible delay. As navigation generally closes somewhere about the 22nd of November in those waters, the ship had but little time to spare. The question was how to get her off the mud and back into the channel expeditiously. The thing immediately needful was to dredge a channel for her, and this was done, including removing the mud from both sides of her. This left the vessel, however, supported upon a mound beneath her that could not be removed by the dredges, nor could a fleet of tugs and the "Zeeland's" own engines, of more than 12,000 horse-power, dislodge the stranded liner. The grip or suction of the mud was too tenacious.

The salvors hit upon what they thought was a happy expedient. They advised cutting the rivets of a number of plates in the ship's bottom so as to let these go, and then to charge the double bottom space and certain of the neighboring compartments with compressed air, the air to leak out through the holes so made, and, in working its way surfaceward, to break the seal between the craft's skin and the adhering mud. This probably would have done well enough, but it would have obliged the ship to go into drydock and to have the plates replaced—work that would have taken a day or two and at a time when every hour counted.

Mr. W. W. Wotherspoon, representing the Yankee Salvage Company of New York city, was called into consultation and proposed a novel substitute, to which the contract salvors and the underwriters agreed. Mr. Wotherspoon sent his men down into the double bottom of the "Zeeland," where they tapped two holes in the inner ends of fourteen brass drainage plugs already in the liner's bottom plating, which had been placed there from the outside when the ship was built. Key wrenches were fitted into these newly drilled holes and the drainage plugs released by unscrewing them outward and allowing them to sink into the mud.

Immediately afterward, threaded pipe connections were screwed into the holes and rubber hose attached thereto. This hose was then joined up to mains leading from a wrecking air compressor which was installed for the purpose. This air compressor had a capacity of 1,000 cubic feet of free air per minute, and the fourteen holes were widely distributed along the ship's underbody.

This done, a stout wire hawser was looped around the bow of the liner, and each end led to a securely moored dredge, where it was passed around the drums of powerful winches. Lines were led to five tandem teams of tugs, representing a total horse-power of 14,000. Besides this, the ship's boats were put overboard to lighten her, some other weights removed for the same purpose, and nearly 1,700 tons of water ballast drained from her bottom tanks. The ship's engines were alternately worked forward and backward at full power, helping to shake the craft violently. Then the compressed air was blown through the bottom outlets, the seal with the mud was thus broken, and inside of ten minutes from the starting of the tugs and the dredges, which previously had been unable to dislodge the "Zeeland," the liner floated and was promptly towed off into deep water. Under her own steam she sailed at once for Montreal, where she was loaded, and a little later left for England before ice interfered. Screw plugs, inserted from within the ship, replaced the original drainage plugs when the compressed air connections were withdrawn. The substitution was a simple matter quickly effected.

Mr. Wotherspoon had an earlier example for his inspiration, but his employment of compressed air was novel. When the old battleship "Maine" was ready for refloating from the bed of Havana harbor, water jets were used around outside of her at the mud line and through holes drilled in the bottom of the hull. In this fashion the seal between the ship's plating and the mud was broken, and when the cofferdam space was ultimately filled the "Maine" floated easily away from her long resting place. The searching and buoyant character of compressed air made Mr. Wotherspoon's method a more certain one, and the rising streams of bubbles spread out and actually provided a supporting film for the big liner.

### The Current Supplement

IN the issue of the SCIENTIFIC AMERICAN SUPPLEMENT for January 23rd, No. 2038, there is an interesting abstract of a lecture delivered by Sir Ronald Ross at Charing Cross Hospital on Malaria and the Transmission of Disease that gives an outline of the history of the theories and the part played by parasites. There is also an account of various investigations by the author that verify modern theories. Applied Electric Science in 1914, by Prof. A. E. Kennelly, of Harvard University, gives a comprehensive survey of the year in this field. An article on the Great Toothed Divers of America, by Dr. R. W. Shufeldt, discusses a remarkable class of prehistoric birds, with illustrations. Our Berlin correspondent sends a timely account of a lecture by a celebrated German surgeon giving his experience on the battlefield during the present war, with comments and explanations of various injuries. A Great Railway Electrification Project tells of plans that are being carried out that will have a decided influence on the future application of electricity for hauling trains, for it includes the handling of both passenger and freight traffic through some of the heaviest sections of our Western mountain country. Excellent illustrations accompany the article. Arithmetical Machines covers the history of these devices, which are much older than most people suppose, and the fundamental theories and principles are set forth clearly and practically. The valuable treatise on Suction Between Passing Ships, that began in the first issue of this year, is completed in the present number with a valuable summary of cases. An article on Fluorescence of Petroleum Distillates sets forth various theories on the subject, and tells of a number of experiments.

# A Submarine for the Austro-Hungarian Navy

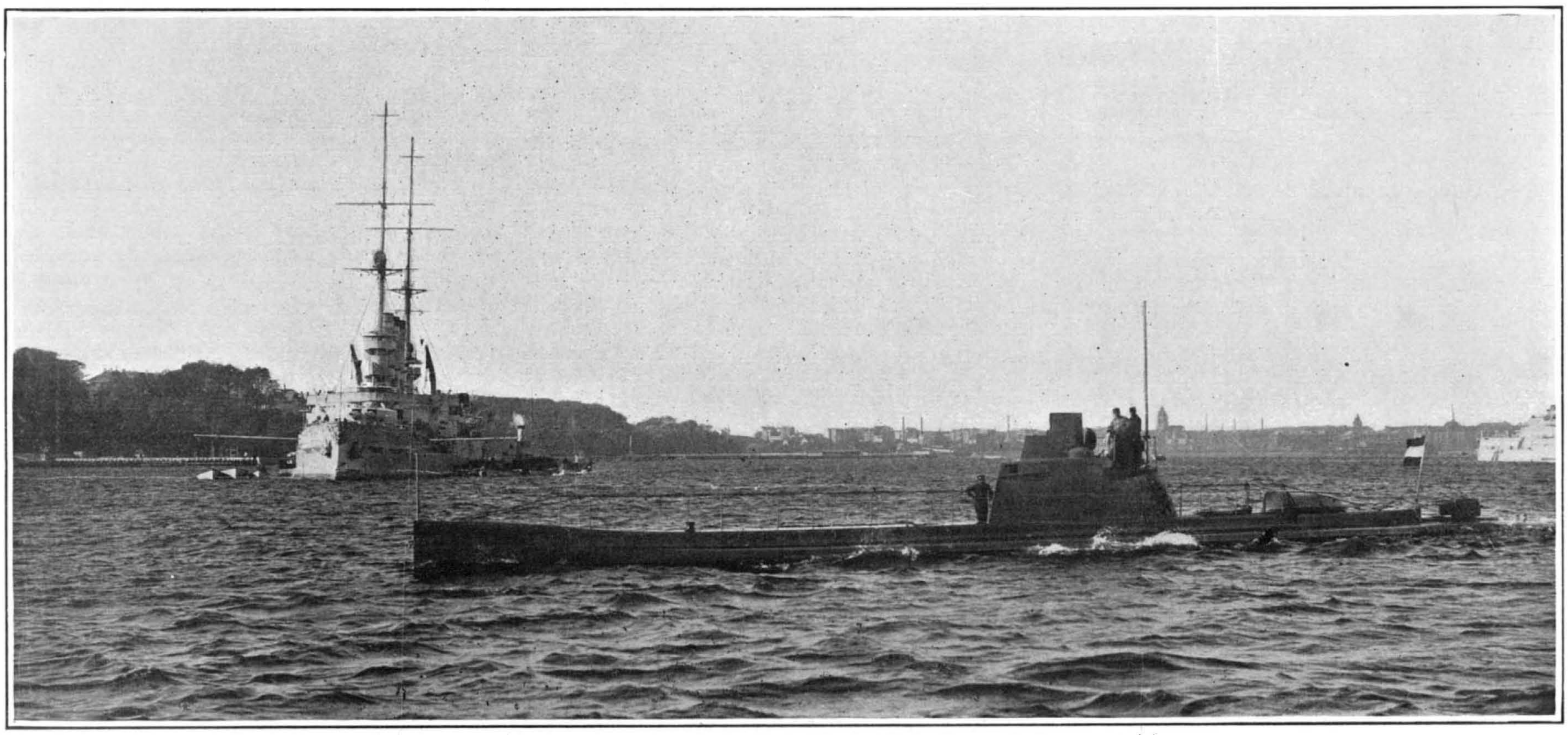
## The Latest Krupp Design in Underwater Terrors

By Frederick C. Coleman

THE latest additions to the submersible craft of the Austro-Hungarian navy are represented in the two boats, "U-3" and "U-4," built at the Germania yard, Kiel, of Messrs. Fried. Krupp, Ltd. These boats, illustrated in the accompanying two photographs, have an extreme length of 142 feet, a breadth of 12 feet 4 inches, and a draught (surface) of 9 feet 8 inches. They have an under-water displacement of 300 tons and a surface displacement of 235 tons. The vessels have a double hull, the inside hull being a cigar-shaped watertight body having a structural strength calculated to resist the hydraulic pressure corresponding to a depth of 165 feet. This inner hull is shown, and a view of the first of these two boats taken shortly after launching is also given. The watertight hull is formed of nine circular welded sections, three of which, amidships, are cylindrical, the others, fore and aft, being conical. The hull is subdivided, by means of bulkheads, into several watertight compartments. The bow section contains the torpedo armament and accessories; the next section is occupied by the crew and store room for electrical batteries, and contains also a galley, with electrical cooking range, and lavatory accommodation. The inner ballast tanks are situated amidships, and just below the conning tower is placed the steering gear for the two pairs of diving rudders. The engine room contains internal combustion machinery and electric motors, while the last watertight compartment aft is reserved for another battery of accumulators.

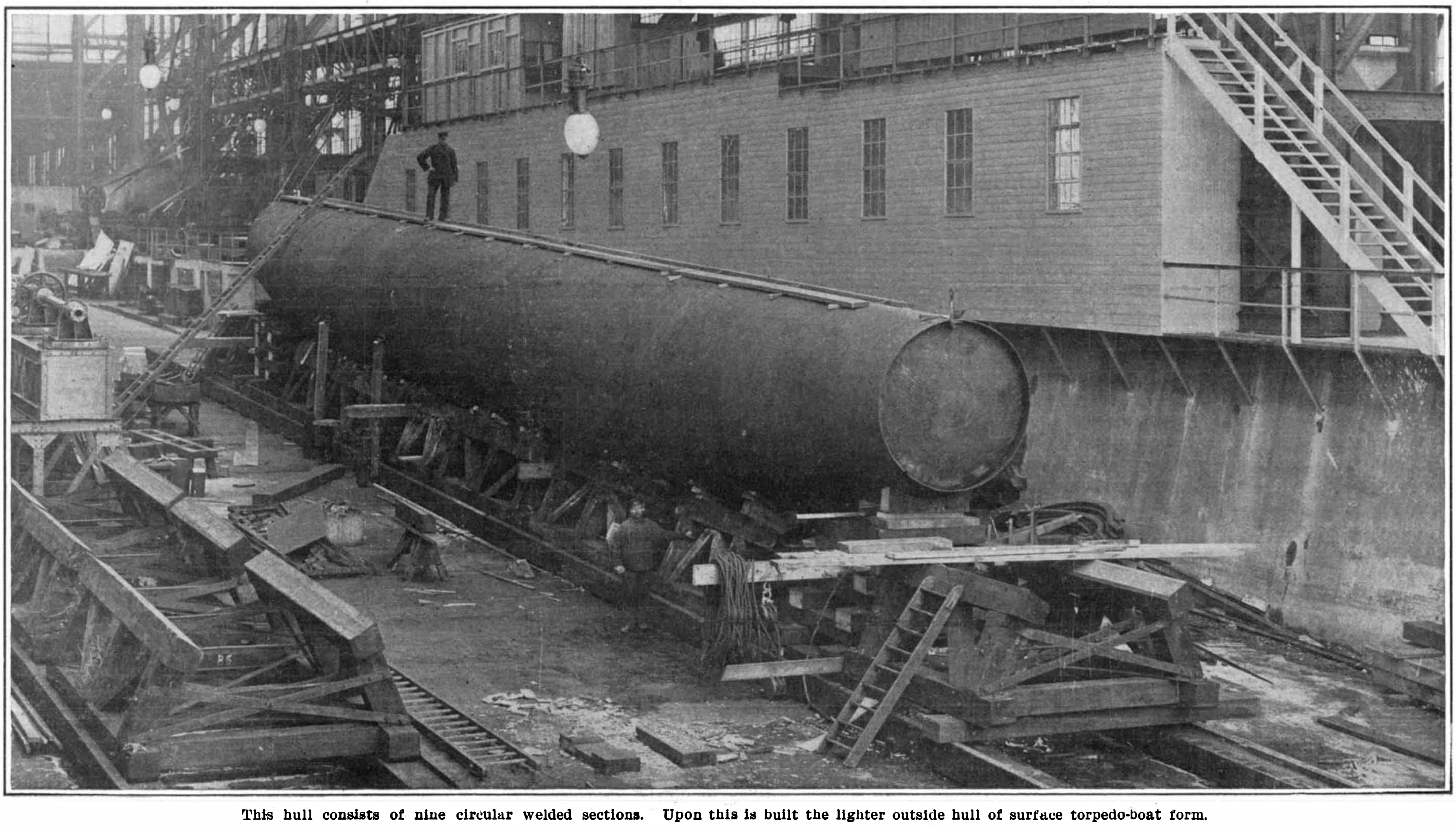
The outside hull does not differ much in shape from that of an ordinary torpedo boat, and is so designed in order to give the boat good sea-going qualities. A weather deck extends throughout almost the whole length of the ship and can accommodate the crew when the boat is traveling on the surface. Between the deck platform and the inside hull the kerosene and most of the water-ballast pipes are fitted. The conning tower, situated amidships, is framed of strong nickel-steel plates capable of resisting the attack of small guns. It is fitted with two periscopes and all the appliances necessary to control the ship in action. The only opening which gives access to the vessel is placed immediately above the conning tower. Communication between the conning turret and the steering gear below is effected

(Concluded on page 89.)



**Length,** 142 feet. **Breadth,** 12 feet 4 inches. **Draught, at Surface,** 9 feet 8 inches. **Displacement:** Surface, 235 tons; submerged, 300 tons. **Speed:** Surface, 12 knots; submerged, 8.6 knots.

**One of two German-built submarines for the Austrian navy.**



This hull consists of nine circular welded sections. Upon this is built the lighter outside hull of surface torpedo-boat form.

**The inner cylindrical section of the latest submarines for the Austrian navy.**

Fig. 1.—Weighing out the formin.

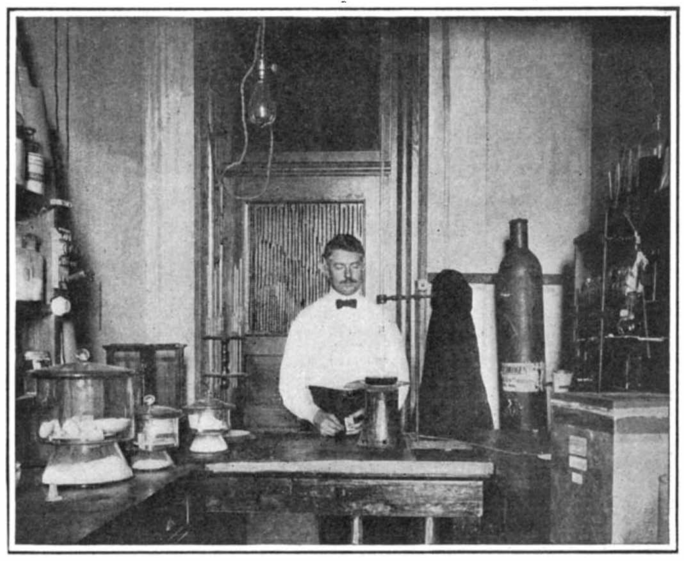


Fig. 2.—Melting the formin and carbolic acid.

Fig. 3.—Filling the molds.

# Synthetic Resins

## Non-inflammable Substitutes for Celluloid and Rubber

NEW synthetic resins have been discovered recently and are appearing on the market under many trade names. The resins are used in the production of materials such as artificial amber, pipe-stems, tooth-brush handles, beads, transparent jewelry, buttons of all sizes, inlaid work, knife handles, fountain pens, etc., and take the place of bone, horn, ivory, celluloid, amber, casein (gallolith), ebony, and hard rubber.

These artificial resins in their final conditions do not melt or even soften appreciably at all temperatures, and do not burn like rubber or celluloid. When heated in the air to temperatures well above 500 deg. Fahr. the resins char and burn slowly without a flame. They are quite insoluble in all ordinary solvents, such as gasoline, alcohol, ammonia, washing soda, and acids.

Recent discoveries made in the Industrial Department of Kansas State University have produced radical departures, both in the synthetic resins themselves and the method of producing the same. These discoveries have revolutionized the method of producing synthetic resins and indeed very great changes and differences are brought about in the resins themselves.

By the old or wet process, the resins are produced very simply by boiling together carbolic acid and formaldehyde in the presence of a third substance, a condensing agent, which serves to hasten the formation of the resins. When formaldehyde and a condensing agent are used the resins are produced in the presence of water and the resins must be separated from the layer of water, washed free of the condensing agent and dried. They are then further heated or molded in whatever way is desirable and the final hard resin is produced by heating, generally under pressure, at temperatures upward of 175 deg. Cent.

By the new dry or anhydrous process, phenol, i. e., carbolic acid, is heated together, in a dry condition, with formin. No water is present during the formation of the resins and no condensing agent is needed, which at times is so troublesome and which must later be removed from the resin by careful washing.

This dry reaction in one simple operation produces the resins, which are at first beautiful golden yellow colored liquids, which are entirely free from any substance such as water or condensing agent which must be removed at considerable expense when the resins are produced by the old or wet process. And these dry liquid resins pass under suitable treatment into solid masses which present very closely the appearance of genuine amber.

Formin, the material used to convert the phenol in its dry condition into the anhydrous resin, is a white transparent substance, of sweetish hot taste, in appearance like table salt and having the odor of salt fish; it is known to the organic chemist under the formidable name of hexamethylenetetramine.

The operator in Fig. 1 is shown weighing out the white salt-like formin. The weighed materials are transferred into a flask shown at Fig. 2, fitted with an air condenser of glass, and are heated carefully. The carbolic acid and formin soon melt to a golden liquid, and after sufficient boiling the liquid is poured, while still quite hot, into molds, Fig. 3, of any desired shape and the filled molds are transferred to an open oven without pressure, where they are further heated for the final hardening. This method of forming the resins has the very great advantage that there is no water or condensing agent from which the resins must be separated and dried. A further great advantage consists in being able to produce these resins rapidly without the use of the counter pressure which is so desirable or even necessary when the volatile formaldehyde is used.

After the liquid resin has been heated in the molds for twenty-four hours, it has solidified and has set into the exact shape of the mold. It is then removed from the molds and returned to the oven for further heating. The resin, as it first comes from the mold, is quite soft and can be bent or twisted into any shape very easily and sets permanently in whatever shape it is held for the final heating. The operator, in Fig. 4, is shown bending between his fingers two soft plastic pipe-stems, which have just been removed from the molds. The soft pieces are replaced in the oven, and heated at a very low temperature for several days; at the end of this heating a beautiful transparent yellow material is produced which is harder than silver, gold, or nickel, marble or ivory. Its tensile strength varies from 5,000 to 6,200 pounds per square inch and even higher. It is very interesting and novel to one unacquainted with the great strength of the material to see three tons of iron suspended from a rod of the resin one inch in diameter. The luster is higher than that of amber or any of the natural resins, and its refractive index (1.645) is greater than that of crown glass.

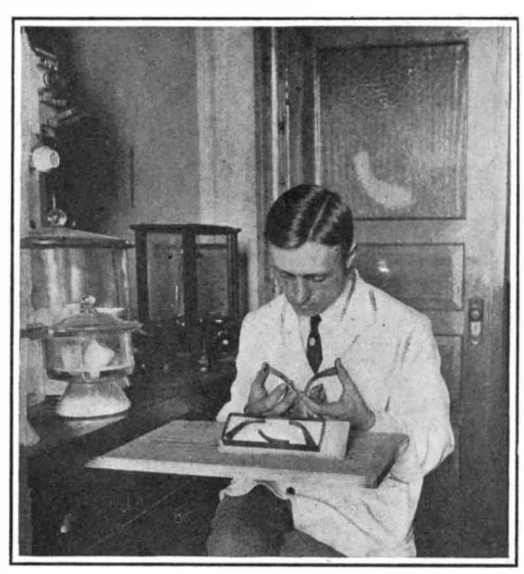


Fig. 4.—Bending pipe bits while gelatinous.

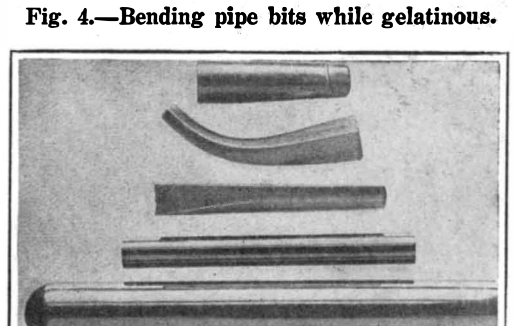


Fig. 5.—Transparent rods and pipe-stems.

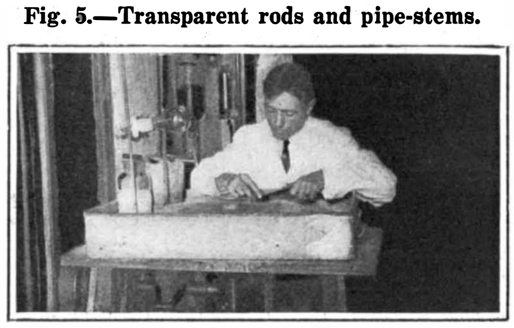


Fig. 6.—Polishing the resins.

The transparent goods are remarkably permanent as regards color. Indeed, one of the great advantages possessed by the dry anhydrous resins over those produced by the wet process is their inertness to color changes caused by direct sunlight. The dry resins do not redden rapidly when exposed to direct sun rays.

After the resin has received its final hardening it is shaped and polished on flat horizontal wheels, with fine emery, carborundum, or tripoli. The final polishing is done with oiled buffing wheels. If the molding has been done with sufficient care, the grinding and polishing is quite unnecessary except where a perfect surface and a very high gloss is desired.

These resins can be produced at a cost which can compete for cheapness with the natural resins, such as amber, or with jet, hard rubber, etc. They may be dyed any color, from a pale yellow or ruby red, to a transparent black of great depth and brilliance. When made into jewelry, such as beads, their high refractive index gives a brilliance and transparency surpassing the finest amber.

The resins are also used as binders or glues, and since they are insoluble and do not melt they are of the greatest value as a glue for making hot-water pump valves, valve disks which withstand 650 deg. Fahr. in dry steam, steam pipe gaskets and valves for acid pumps, and pump packing of all kinds. Lists of articles which may be made from these resins when properly combined with suitable fillers are indeed legion. Light pulleys, very uniform in weight, artificial board from sawdust and wood fiber, frictionless bearings for use in machinery for cotton, wool, and silk industries where the machinery cannot be oiled or for bearings under water, ebonite and compoboard, switchboards, heat and electric insulating handles, and heat and electric insulating parts of every conceivable kind are produced at prices which compete readily with the less satisfactory articles which have been on the market up to the present time. Very beautiful transparent and opaque handles are being produced for chafing dishes, coffee percolators, samovars, etc., where strength and beauty must be combined with good heat insulating qualities.

Paints, varnishes, and lacquers are also produced from these resins by dissolving in suitable solvents such as alcohol, acetone, and banana oil, the resins when they are in the initial or soluble state. These coatings, after heating, are almost indestructible by fumes, acids, solvents, salts, or chemicals which easily corrode metals. Brassware, such as beds, urns, candelabra, chandeliers and auto lamps, when lacquered with the resin do not tarnish, as the lacquer film is impervious and indestructible. Varnished surfaces may be left in cold or even boiling water without losing their luster and the paints, when made with the proper fillers, are the best possible protection for metal surfaces exposed to corrosive agencies. The ordinary paints under accelerated electrolytic tests break down in less than twelve hours; coatings made from synthetic resins are unaffected in any way in one hundred hours.

These varnishes and lacquers make the best possible impregnating liquids for electric purposes. The dry films have a dielectric strength of 105,000 volts per millimeter and a resistance of 28 by $10^9$ megohms per cubic centimeter. Paper cartons coated with the varnishes become impervious not only to liquid fats and oils, but also to kerosene and gasoline.

# Curiosities of Bygone Ages

## Relics from New Mexico and from Bible Lands

Relics dug from ancient ruins near Aztec, New Mexico.

### Relics of an Ancient People in New Mexico.

BY E. P. WILSON.

AZTEC, New Mexico, is located in the northwest corner of the State and in the midst of the ruins of a prehistoric race that at one time was thickly scattered throughout the region. Irrigated farms now line the valley of the Rio de Las Animas River, where once the roughly built stone dwellings of the ancient people stood. No writings of any kind remain to tell who the builders of these pueblos were or where they went. The Navajo Indian occupied the region when the first white men entered this mountain recess over thirty years ago. The Navajo traditions are unreliable as to the vanished race. One of these is that the Navajo chased the ancient people into the river and they all were turned into fish.

In excavating one of these ancient dwellings that might have been inhabited as late as 1,500 years ago, Mrs. Orren Randall, living on a farm about a mile west of the modern Aztec, uncovered a curiosity that is one of the most interesting of relics. It is an image or idol, formed of the clay like the pottery that is found so plentifully here. The image is perhaps 16 inches high and is perfect with the exception of one missing leg. It was found with its back against the back of a human skeleton. At the side was found a large bowl with handsome decorations as well as several smaller bowls and mugs.

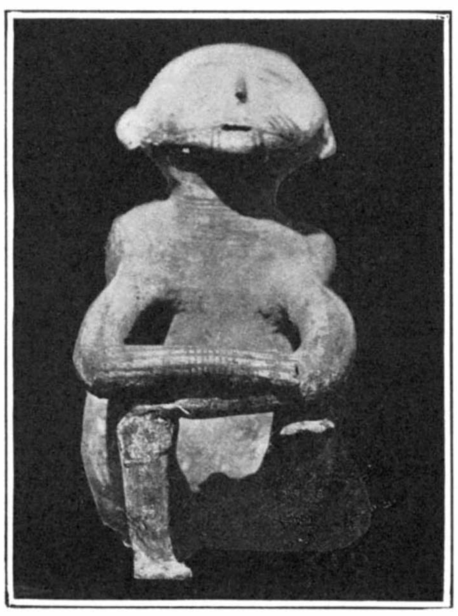


Image of clay discovered in the New Mexico ruins.

Archæologists have viewed the ruins near where this relic was found, and they estimate that it is 1,500 years since the ruins were inhabited. Arrow points, bone needles, stone ax heads, rocks for grinding grain, corn cobs, bowls of all sizes, mugs, vases, beads, pumpkin rinds and many other things are found by digging into the dilapidated dwellings.

### Another Remarkable Discovery in Babylonia.

BY EDGAR J. BANKS.

In the SCIENTIFIC AMERICAN not long since there appeared a translation of a long inscription upon a large clay cylinder of Nebuchadnezzar, king of Babylonia from 604 to 561 B. C. The cylinder was found in the walls of the temple at Marad, south of Babylon, where Nebuchadnezzar buried it for future generations to read. Near the end of the long inscription is an account of the restoration of the temple at Marad in these words:

"At that time in the temple of Lugal-Maradda, my lord, in Marad, whose foundation no former king had seen since ancient days, I sought and found the ancient foundation stone, and upon the base of Naram-Sin, my ancient ancestor, I fixed its foundation. I wrote an inscription and my name and placed it therein."

No tale in fiction is more marvelous than the tale that the archæologist may now tell. The foundation stone of Naram-Sin, the same inscribed stone which Nebuchadnezzar says "no former king had seen since ancient days" has been discovered. A photograph of the inscription upon it is here reproduced.

Who was Naram-Sin, this ancient ancestor of Nebuchadnezzar? Not long ago, when his name first appeared, he was regarded as one of the mythical characters with which prehistoric times was supposed to be peopled. Some years ago in the North Babylonian ruin Abu Habba, the ancient Sippar of the Bible, there was found an inscribed cylinder of Nabonidus, the last king of Babylonia, 555-538 B. C., and the father of the Biblical Belshazzar. In the inscription Nabonidus says that while restoring the temple of the sun-god, he dug to its foundation and saw the foundation stone of Naram-Sin, the son of Sargon, which no former king had seen for 3,200 years. Scholars were amazed at the statement, and at the long period of time which was mentioned. If Naram-Sin lived 3,200 years before the age of Nabonidus, or before 550 B. C., his date was 3750 B. C. Though he was regarded as a mythical being, inscriptions from both him and his father, Sargon, began to appear. On a clay tablet was the story of the birth of Sargon, very similar to that of the birth of Moses. Finally on a rock in the mountains of Armenia a sculptured figure representing Naram-Sin was discovered. Then in several of the Babylonian ruins large square bricks bearing the names of Sargon and Naram-Sin were found and now a score or more of inscriptions on gold, stone, and clay have convinced us that Naram-Sin and his father were real beings, and have taught us much of their history.

Though Naram-Sin was one of the earliest known kings, it is still to be proved that he lived 3,200 years before Nabonidus, or 3750 B. C. Modern scholars believe that they have evidence that he lived a thousand years later than that date, but undoubtedly, when Nabonidus made the statement, he had before him the long lists of the Babylonian kings, which we know to have existed, and fragments of which have been found. Future discoveries may show that he was correct. Unfortunately Nebuchadnezzar, in his cylinder inscription, does not say how long before his time Naram-Sin lived. We are accustomed to call even the age of Nebuchadnezzar exceedingly ancient, yet it is certain that Naram-Sin lived as long before the time of Nebuchadnezzar as Nebuchadnezzar lived before our time.

The foundation stone of Naram-Sin is in the form commonly called a door-socket. The Babylonians seem to have been unacquainted with hinges for their doors. At one side of the doorway was placed a large flat stone with a cup-shaped hollow in its center. Into the hollow was fitted the wooden door post, which revolved as the door was opened and shut. Similar door posts and door sockets are still to be seen in houses of modern Babylonia. The stone door socket corresponded to our corner stone or foundation stone. It sometimes bore about the hollow, where it might easily be seen, the inscription of the royal builder.

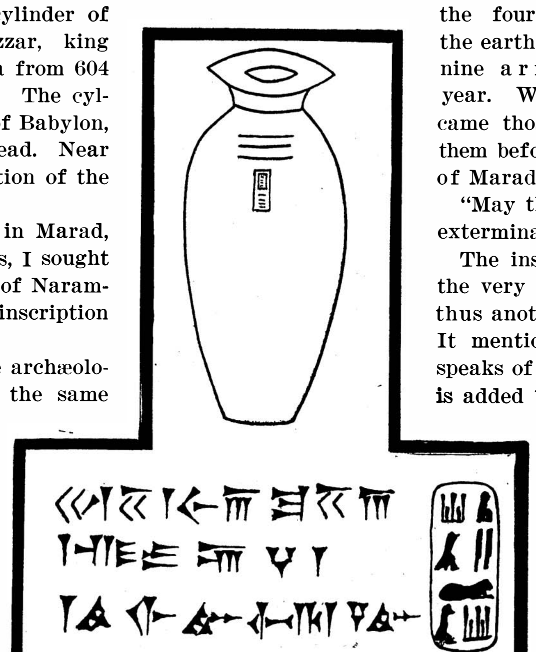
Fragments of the vase of Ahazuerus in the New York Public Library.

The inscription of Naram-Sin, seen by Nebuchadnezzar and recently found by the Arabs, is on a round yellowish calcite stone about twenty inches in diameter. The uninscribed part of the stone has been cut away. The inscription in its two columns contains thirty-eight short lines. Its characters are of a very archaic form. Its translation reads:

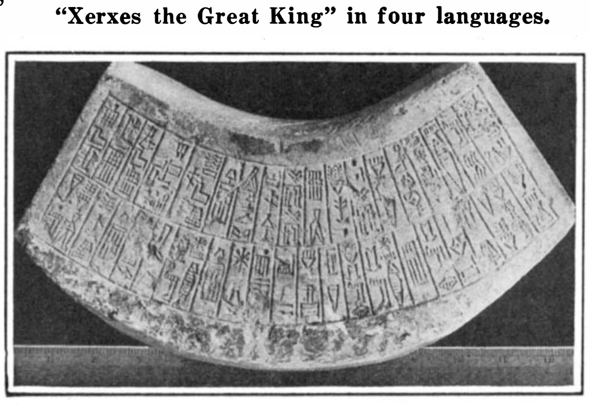
"Naram-Sin, the mighty king of the four quarters of the earth, who subdued nine armies in one year. When he overcame those armies he made their three kings captive, and brought them before the god En-lil. On that day Libit-ili, his son, the governor of Marad, built the temple of Lugal-Maradda in Marad.

"May the gods Shamash and Lugal-Maradda destroy the estate and exterminate the seed of him who alters this inscribed stone."

The inscription is of historical importance. It positively identifies the very ancient Marad with the ruin mounds of Wana-Sadoum, and thus another long lost city may be restored to the map of Babylonia. It mentions a son of Naram-Sin, Libit-ili, hitherto unknown, and speaks of him as the governor of Marad. Another god, Lugal-Maradda, is added to the Babylonian pantheon, and what is no less interesting is that the accuracy of Nebuchadnezzar's statement is established. The very inscription which two thousand years ago he said he saw at the foundation of the temple, and which even then had already lain there for perhaps three thousand years, has been discovered.



"Xerxes the Great King" in four languages.



Inscription of Naram-Sin, King of Babylonia, 3750 B. C., which Nebuchadnezzar says that he saw.

### A Quadrilingual Inscription From Queen Esther's Husband.

The prize for which the excavator among the buried cities of the ancient civilizations of the Orient is always searching is a bilingual inscription. If one of the two languages of the inscription he hopes to find has not yet been deciphered he thus has a key to a long-lost tongue. With that key he hopes to unlock the secrets of some ancient kingdom and restore to the world history and literature which has long been forgotten. The most familiar of the trilingual inscriptions is the famous Rosetta Stone in the hieroglyphic and demotic languages of ancient Egypt, and in Greek. Arabs discovered it at Rosetta in 1799, and it enabled Champollion to translate the inscriptions on the monuments of ancient Egypt. Another trilingual inscription of equal importance was found among the ruins of the palace of the Persian king, Darius, at Persepolis. Two of its three languages were Persian and Babylonian. By means of it Grotefend deciphered the cuneiform language of Babylonia and restored to the world the vast

(Concluded on page 89.)

# Inventions New and Interesting

## Simple Patent Law; Patent Office News; Notes on Trademarks

### Cleaning A City's Water Mains

**By J. F. Springer**

PEOPLE in general have no realization of the effect of sedimentation and incrustation upon the operation of a city's water system. Indeed, it is probable that, because of the gradual character of the changes, many municipal governments have only a very imperfect knowledge of what is really transpiring. The deposits have two effects. First, they cause friction from the irregularity of surface produced. It is reliably stated that nodules projecting no more than $\frac{1}{16}$ or $\frac{1}{8}$ inch may seriously affect the flow of water through pipes, even though they are separated from one another by appreciable distances, and involve only a small fraction of the interior area. It is even said that the variations in smoothness of the interior coating of a new pipe may make a difference in delivery amounting to as much as 25 per cent. An illustration of the retarding effects of irregularities is seen in the necessity of cleaning a ship's bottom fouled with incrustation no thicker than $\frac{1}{4}$ inch. The second effect of deposits consists in the reduction of the effective diameter of the pipe. The combined effects of the two may become very serious. An 8-inch water main in the city of Camden, N. J., had become so obstructed from the accumulations of half a century that, instead of delivering over 1,000,000 gallons of water per twenty-four-hour day, it had a capacity of only 223,000 gallons. Another illustration may be derived from the experience of Belle Plaine, Iowa. Here a cast iron water pipe nearly a mile long and 6 inches in diameter had a capacity when clean of 335 gallons per minute, with a pressure of 60 pounds. This pipe became so clogged that a pressure of 125 pounds was necessary in order to deliver 248 gallons per minute.

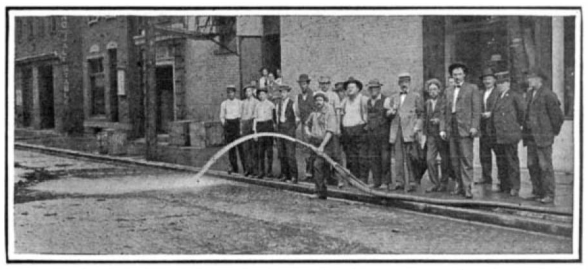


**Fig. 1.—This indicates the pressure and flow of water in a street main that is obstructed by sediment and incrustation.**

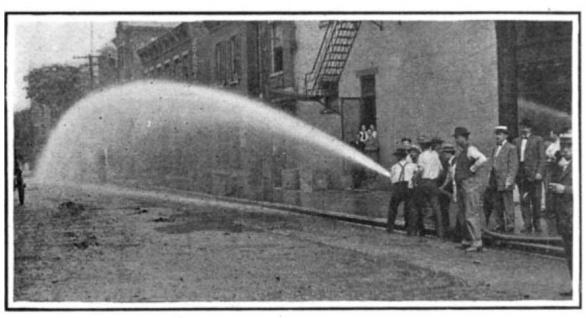


**Fig. 2.—A test of the main shown in Fig. 1 after it had been partially cleaned.**

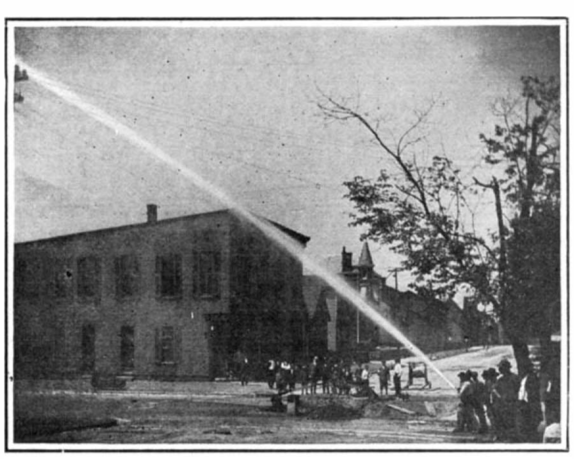


**Fig. 3.—This shows the pressure made available by fully cleaning the water main.**

Not long ago the city of Hartford, Conn., came to the realization that its system of water mains would soon be inadequate to supply the demand. There are three mains, two of them having a diameter of 20 inches, and one a diameter of 30 inches. There were two methods of meeting conditions, either of which promised success. First, a new supply pipe, 36 inches in diameter and $6\frac{1}{4}$ miles in length, could be laid at an estimated cost of $270,000. In five years the compound interest at 5 per cent would amount to $74,500. The alternative solution of the problem was to clean the pipes already laid, and thus bring them back to their original capacity. It was estimated that this method of handling the matter would enable the city to defer the laying of a new main for five years. Accordingly, it was a question of the cost of the cleaning. This was found to be only a fraction of the $74,500. Consequently, it was decided to clean out the pipe, and two thirds of the total of nine miles was cleaned.

There are several mechanical methods of cleaning. At Hartford a curious appliance, not unlike some huge caterpillar, was passed through a long length of pipe. This appliance cut away incrustations and scraped away loose material. During the application of this mechanical device a flow of water was maintained in the pipe. In this way the *débris* was flushed out. The whole apparatus was a little less than 9 feet long, and consisted of a number of parts secured to a central shaft, which was jointed or hinged at a number of points. This jointing of the shaft makes the 9-foot apparatus quite flexible, so that corners can be readily rounded. The first part of the cleaner consists of three spiders arranged on the central shaft like vertebræ on the spinal cord. These spiders are provided with saw-tooth blades projecting perpendicularly to the shaft, which cut and tear away the incrustation and scale adhering to the pipe wall. Behind these forward spiders are two others, provided with smooth scrapers. The work of the scrapers is less violent than that of the saw teeth, and they clear away material left by the latter. Next are two pistons which fit the pipe wall closely by means of leather gaskets pressed out against the pipe by steel springs. Valves are arranged in the pistons to provide for a regulated passage of water, so that when the apparatus is in operation a stream of water is kept flowing through the pistons, and on ahead of the whole appliance, to wash the loosened material forward, and, in fact, to carry it ultimately out into the open. Back of the pistons are two "vertebræ" which carry other scrapers, arranged in the form of right and left-hand screws, and hardened guide rollers are so arranged as to allow these latter scrapers just to touch the surface of the pipe. On each of the five spiders are arranged three deflecting disks, to throw a current of water out from the center through the cleaning blades and against the walls of the pipe in order to assist in the cleaning and to keep the various scrapers clear.

The methods of getting cleaning apparatus through the pipe are interesting. In accordance with one, the apparatus is dragged through a pipe by means of a rope and winch. Another procedure makes use of the force of the stream of water, but a considerable pressure is necessary. This was the method employed at Hartford, and the machine was carried through by means of the two pistons which provided resisting surfaces to the water current. The valves referred to above allowed the water a restricted opportunity to pass through and ahead and thus maintain a continuous flushing stream. It is estimated that 1,655,000 gallons of water were employed in cleaning 33,093 feet of water main in Hartford, which was about 20 per cent of a day's supply for the city.

The suggestion had been made that the cleaning of cast iron pipe is frequently followed by pitting at a more rapid rate, and it is possible that this may sometimes be the case; but experience has shown that no harm is done to the interior of the pipe by this process.

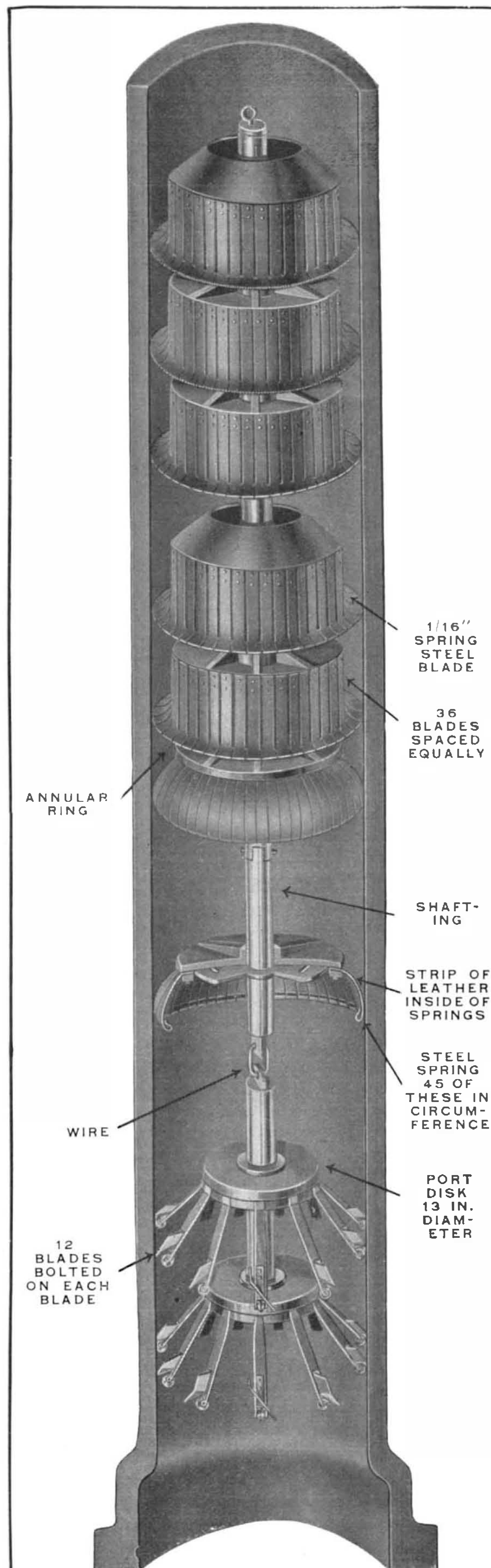
### Selling Patent Rights

OFTEN we are asked to recommend some individual or company supposed to be in a position to sell a patent on an invention; but it is impossible to give definite information because no agency exists that can render such a service for patentees generally.

*Machinery* gives the following advice on the subject:

Selling patents is very different from selling machines or real estate. The range of things covered by patents is almost unlimited, and capitalists, manufacturers, and others interested in promoting inventions for profit are widely distributed in enterprises of every description or attached to none at all. The work calls for innumerable experts. A person qualified to sell patents on shoe machinery would hardly be able to handle machine tool improvements or agricultural implements successfully. The technical side of a patent selling business would alone require encyclopedic knowledge in a person qualified to sell all kinds of patents, and the commercial side would demand a practical acquaintance with commercial conditions in almost every trade.

An inventor with ability enough to work out a practical and valuable invention should be able to apply his powers with equal energy to effecting such relations with others as will result in making his invention profitable. That such a combination of the inventive and commercial faculty rarely exists is not equivalent to saying that it cannot be developed. It can be; and a man who finds himself in possession of the inventive faculty should carefully study the commercial prospects and conditions and learn how to secure financial co-operation for his ventures. To merely invent is not sufficient; the inventor should be able to produce the children of his brain in shape for others to enjoy.




**A machine which is passed through a water main to remove incrustation.**

## A Submarine for the Austro-Hungarian Navy

(*Concluded from page 85.*)

by voice pipes. Aft of the conning tower is a conning platform for surface navigation. The tower is inclosed in a structure, designed on ship-shaped lines, intended to diminish the resistance met when traveling under water. These two submersibles are propelled by two two-cycle heavy oil engines, aggregating 600 horse-power for surface navigation. Two electric motors, designed to develop 320 horse-power, are used for propulsion when the boat is submerged. The motors operate two reversible screws. The engine-room outfit comprises two main and one auxiliary motor-driven bilge pumps, two hand-worked bilge pumps for exhausting bilge and ballast water, air compressors and all accessories. A particular feature of German submarine naval policy is the provision for salving appliances. These, in a way, have preceded the construction of submarine craft. This feature is also emphasized in these boats. They carry a safety keel weighing 5 tons, which can be detached by working a very simple gear, merely by the movement of a handle. By emptying the ballast tanks the boat can be floated in 1½ minutes. Several appliances have been fitted to purify vitiated air, and thus prolong the stay under water, so that the liability to accident is greatly minimized. Air connections are fitted on the outside plating, which, under certain conditions, would allow communication to be made with the atmosphere. A buoy carried on deck can be unfastened from the inside of the hull in order that a telephonic connection can be established with a rescuing crew. Each boat is fitted with two 18-inch Whitehead torpedo tubes and carries a supply of three torpedoes. The surface speed at trials was 12 knots, but it is anticipated that it will be surpassed in deep water trials; the submerged speed is 8.6 knots. At an economic speed of 10 knots the radius of action is given as 1,200 miles above water and 60 miles submerged, the speed in the latter case being 6 knots.

## Curiosities of Bygone Ages

(*Concluded from page 87.*)

literature of ancient Mesopotamian civilization. The language of the mysterious Hittites is still undeciphered, yet several scholars, confident that they have found its key, have published attempted translations, only to find that their labor has been in vain. Men have long been searching for a bilingual inscription, one of whose languages is Hittite, and one such inscription has been found. It is a little silver object about the size of half an orange, now in the British Museum. It bears the words "Tarkendemos King of Ermes" in the cuneiform language of Babylonia, and also some Hittite hieroglyphs which probably mean the same thing, but the hieroglyphs are too few to be of service.

Recently there has been presented to the New York Public Library three fragments of a large onyx base bearing upon its side a quadrilingual inscription. As far as I know this is the only quadrilingual inscription yet discovered. As all of its four languages have been deciphered, it is no longer valuable as a key to a lost tongue, yet it is no less interesting. It sheds new light upon ancient customs, and is evidence of the great intercourse among the nations of the early world.

The onyx vase, when perfect, stood 13 inches high. It had a wide lip, a short neck, and its sides curved gracefully down to its small base. The marks upon the interior walls show that the stone was turned upon a lathe. On the outer wall, just beneath the neck, are three lines of cuneiform writing. The first is in Persian, the second in Elamitic, and the third is in Babylonian. Beneath the three cuneiform lines is a vertical line of writing in Egyptian hieroglyphs. The upper of the hieroglyphs are inclosed in a cartouche, showing that they spell a royal name. The inscription is very short, for in each of the four languages it merely

says: "Xerxes the Great King."

The purpose which the vase served is evident. It was the custom of the ancient Oriental kings and nobles to present votive objects to the temples and shrines; thus they hoped to win the favor of the gods. The most common of such objects were vases of rare stones or of beautiful form. Sometimes the beauty of the stone was the only adornment required; other votive vases were inlaid with ivory and bright stones, or engraved. Most of them were inscribed with the name of the giver. That none might fail to know who was the giver of this beautiful vase, Xerxes had his name inscribed upon it in four languages. To what temple or shrine it was presented is no longer certain, for it was found by wandering Arabs. Evidently, however, it was presented to some prominent religious edifice to which people from the most distant lands resorted, where Persians, Elamites, Babylonians, and Egyptians worshiped.

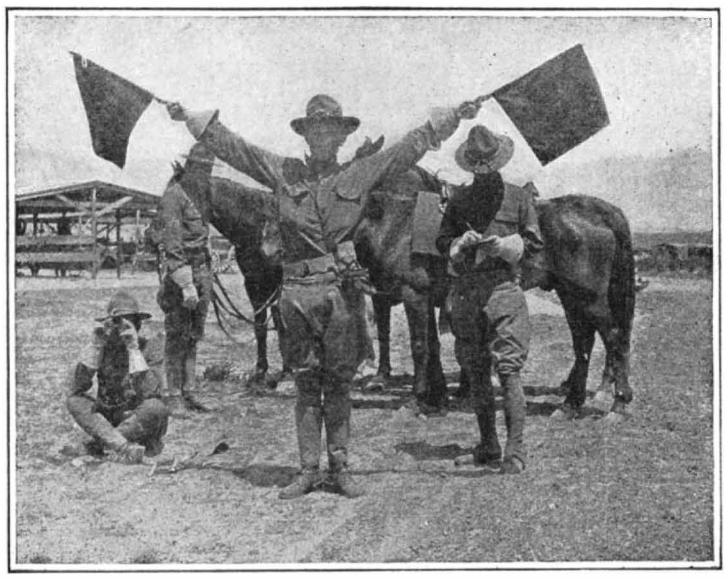
The name of Xerxes on the vase is of scarcely less interest than the quadrilingual inscription, for Xerxes is no other than Ahazuerus, the husband of Queen Esther of the beautiful Bible story. This story has often been called a fairy tale, and many a scholar has claimed that of all the Persian kings none bore the name of Ahazuerus. Xerxes was the Greek pronunciation of the name, with which we are familiar, but the pronunciation of the name as it was written in Babylonian characters upon the vase is Hi-shi-'i-ar-sh-'a. So the great Assyrian king whom the Greeks called Sardanapalus was known to the Hebrews as Osnapper and to the Assyrians as Assurbanipal. The apparent differences in the ancient names may easily be accounted for by a simple law of phonetics. Ahazuerus and Xerxes are the same, so scholars are now agreed.

In 1852 Mr. Loftus dug a few trenches into the mound containing the ancient royal city of Shush or Susa. It was the same mound in which the French later found the famous stone engraved with the Hammurabi code of laws. There were found the ruins of Shushan, the palace in which Queen Esther lived, and in the palace were numerous inscriptions telling of its history. In 1884 Dieulafoy uncovered the famous banquet hall which figures so prominently in the Book of Esther. Its limestone walls are still standing, and little but its roof, which was supported by thirty-six great columns of stone, has fallen. The walls were highly polished, and the parts which were of stucco were painted red. The floor was paved with bricks. Naturally the interior decorations have perished, but the rugs and draperies of ancient Persia probably surpassed in beauty those of the modern country. In the rear of the hall, beneath a crimson canopy, was the golden throne, and before it were rich carpets which the king's feet alone might tread. There sat the king who received Queen Esther, and who gave as a votive offering to some temple the beautiful onyx vase which is now in the New York Public Library.

### Causes of Forest Fires

REPORTS on the forest fires in northern Idaho and Montana state that 35 per cent are caused by railroads, 26 per cent by lightning and 10 per cent by campers, the remainder being due to burning brush and miscellaneous unknown causes. There is one frequent cause of forest fires that is seldom referred to and which has not received proper attention from the authorities, and is those set maliciously and those started by men who expect to earn a few dollars by helping to fight the conflagration they are responsible for. As these latter are usually started near the railroads, these companies generally get the credit for the damage.

**An Improved Method of Recording and Reproducing Sound.**—In a patent, No. 1,101,906, Francis W. H. Clay, of Pittsburgh, Pa., presents a method of recording sound waves, in which he seeks to suppress noises by forcing a vibrating member to regular vibration of higher frequency than the sound waves, independently of the source of the sound wave frequency.



# Helpless United States

YOU hear much, these days, of national defense, of our paucity of soldiers and war material. What are the facts? Can we defend ourselves from invasion by a foreign power? How does our Army, how does our Navy compare with the military and naval forces of other powers?

## The United States—A Third Class Power

In the next magazine number of the Scientific American, to be published on February 6, 1915, these important questions will be taken up. Do you know that there are not enough regular troops in the United States Army to defend New York City? Do you know that we would have to give up the Pacific coast practically without striking a blow, if we were invaded from that side? Do you know that our State Militia is, on the whole, rather badly organized and inefficient—that it will prove anything but the second line of reserve which European powers can summon in emergency? Do you know that we are a third-class naval power?

These questions vitally concern every American citizen. They will be exhaustively discussed in the February magazine number of the Scientific American. There you will be told impartially how many ships we have and how many we need; you will be told what is our actual military strength and what it ought to be; you will be told how woefully deficient we are in munitions of war.

## More Interesting War Articles

Although the subject of national defense will be the most important that will be taken up in the February magazine number, the technical aspects of the present European conflict will also receive popular treatment. To say that there has never been a conflict like this is trite but true. Each day reveals some new artifice, scientific in character, of which the public knows nothing. It is the peculiar province of the Scientific American to describe and illustrate these developments in the art of warfare.

We hear much these days of bomb-dropping, for example. What are the difficulties of bomb-dropping? What are the dangers incurred by the bomb dropper? Mr. Carl Dienstbach's article, "Aircraft, Artillery and Bomb-Dropping," will take up these questions critically.

## Detailed Pictures of Machine Guns

There will be detailed drawings of the Maxim machine gun, which is playing such a great part in this war, and also of the Lewis gun, this latter being an American weapon which has found its first application in the present European war.

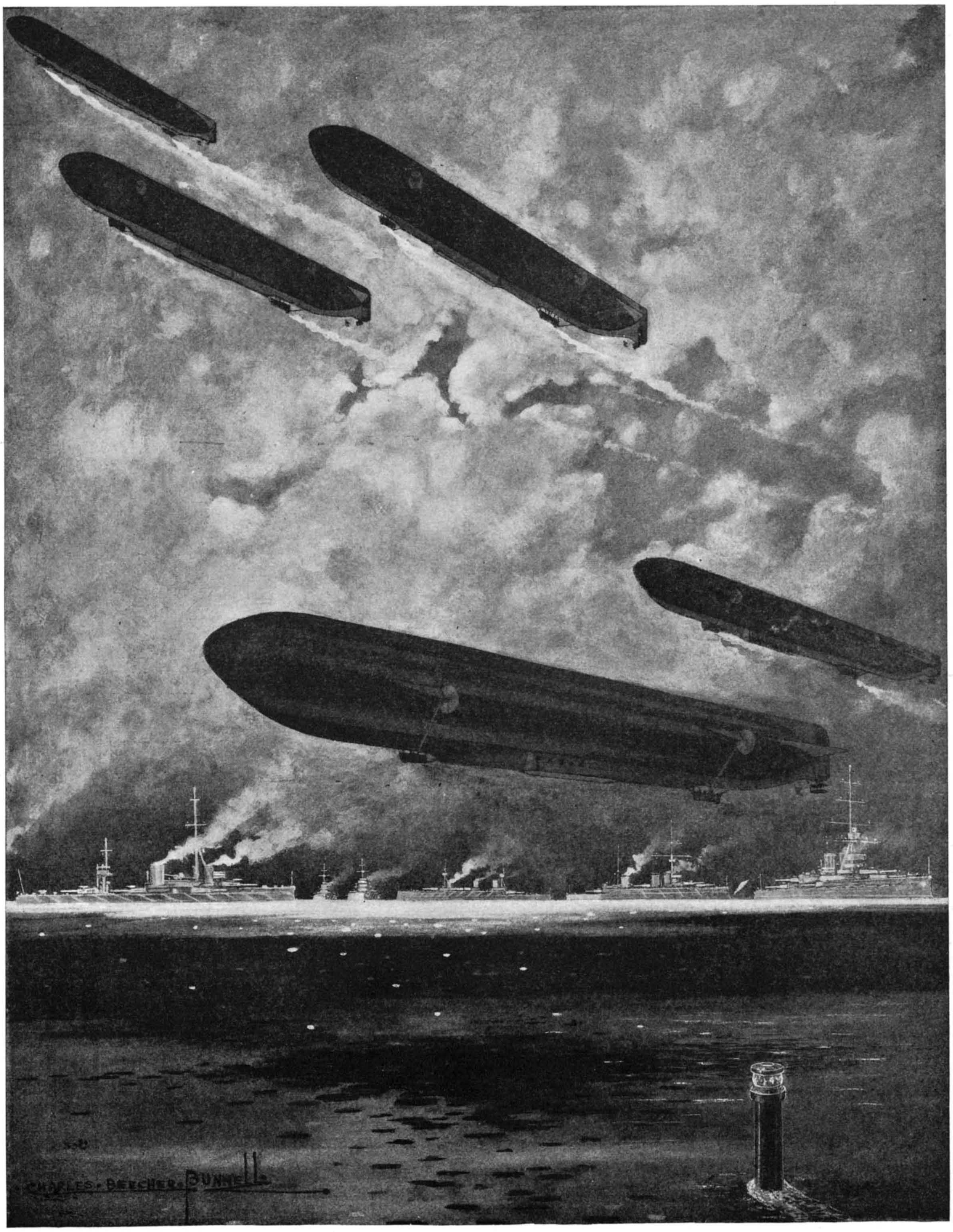
"The Motorcycle in War" is the title of an article which will reveal the part that a very recent improvement in locomotion is playing in battle.

Besides these articles there will also be many pictures from the front—all of them of both popular and technical interest.

There will also be material of a generally interesting scientific character for those who wish to keep abreast of the scientific times.

**The Scientific American is sold by all newsdealers**

# SCIENTIFIC AMERICAN




Vol. CXII. No. 5
January 30, 1915

Munn & Co., Inc., Publishers
New York, N. Y.

Price 10 Cents
$3.00 A Year

# SCIENTIFIC AMERICAN

**Founded 1845**

**NEW YORK, SATURDAY, JANUARY 30, 1915**

Published by Munn & Co., Incorporated. Charles Allen Munn, President; Frederick Converse Beach, Secretary; Orson D. Munn, Treasurer all at 361 Broadway, New York

Entered at the Post Office of New York, N. Y., as Second Class Matter
Entered as Second Class Matter at the Post Office Department, Canada.
Trade Mark Registered in the United States Patent Office





**Subscription Rates**

| | |
|---|---|
| Subscription one year | $3.00 |
| Postage prepaid in United States and possessions. Mexico, Cuba, and Panama | |
| Subscriptions for Foreign Countries, one year, postage prepaid, | 4.50 |
| Subscriptions for Canada, one year, postage prepaid | 3.75 |

**The Scientific American Publications**

| | |
|---|---|
| Scientific American (established 1845) per year. | $3.00 |
| Scientific American Supplement established 1876. " " | 5.00 |
| American Homes and Gardens " " | 3.00 |

The combined subscription rates and rates to foreign countries including Canada, will be furnished upon application
Remit by postal or express money order, bank draft or check

**Munn & Co., Inc., 361 Broadway, New York**

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

*The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.*


## The Military Value of Airships

THE recent raid of German aircraft on England and the dropping of bombs on English coast towns confirm the view which military engineers of all nationalities long ago expressed when they discussed the efficacy of large dirigibles in technical journals. Although twenty or more bombs were cast upon the Norfolk coast towns, the damage to property and the loss of life was anything but what we had been led to expect from the terrible accounts of a Zeppelin's destructiveness with which we were regaled in the daily press before the war. Even the moral effect of such attacks must be slight, if they are often repeated. If Rheims went more or less placidly about its business despite steady bombardment, as we are told, it is not likely that the English will be very much intimidated by exploits such as those of Antwerp and Yarmouth. Indeed, whatever moral effect there may be is more likely to redound to the disadvantage of the attacker. After the bombardment of Scarborough and Hartlepool, the English recruiting offices were thronged with angered volunteers. A similar result will undoubtedly follow the attack from the air upon the Norfolk coast towns.

If, then, the giant airship has not lived up to popular expectations, what is the good of it at all? It must have its uses. The Germans have not without reason persevered in the face of disaster after disaster in bringing their airships to a pitch of perfection which has aroused the admiration of aeronautical engineers in all countries. To us it seems that while the Zeppelins and other dirigibles have not been conspicuously successful in military operations, they have a useful function to fulfill at sea. A vessel which can stay in the air for thirty-six hours, which can travel at an average speed of from forty to sixty miles an hour, which is equipped with wireless apparatus of considerable range, which can hover over a single spot for hours, if need be, may obviously perform a very useful service in locating that fleet of dreadnoughts which is Great Britain's chief bulwark of safety. We have not the slightest doubt that the location of the principal British ships is accurately known to the Germans, thanks to their fast dirigibles. Of the dirigible's value in reconnoitering we had ample proof when the "Hogue," "Aboukir," and "Cressy" were sunk—three British ships which were sighted by a Schütte-Lanz airship, whose commander wirelessed their location to his base with the result that a German submarine was able to find them and sink them in a fraction of the time which would have been entailed had ordinary sea-scouting been resorted to.

The enormous size of the rigid dirigible has perhaps been the chief reason why it has proven so ineffective upon the field of battle. Let us not forget that land-scouting can hardly be effectively conducted at heights greater than five thousand feet, that anti-aircraft guns have a range of fully twenty thousand feet, and that an airship as big as the average ocean steamer is a mark far more easily found at five thousand feet than a small aeroplane. At sea it is otherwise. Battleships can be sighted and identified from great distances far out of gun range. An area of several hundred square miles can be safely explored from a height of four thousand to five thousand feet. By means of its powerful wireless plant the airship is in constant communication with its base. Who knows but the naval raid upon Scarborough and Hartlepool was undertaken only after a very careful reconnaissance, which revealed the location of every important British battleship and cruiser, and which enabled the German naval officers to time their operations so that they might carry out their purpose unmolested by a fleet in the vicinity?

And this brings us to the consideration that, if the proper sphere of the Zeppelin is that of naval scouting, it is a prostitution of those wonderful ships of the air to use them for the night-raiding of undefended towns and villages. Not alone do these raids, as we have shown, stimulate the military ardor of the British, but they serve to arouse a widespread indignation, on the ground that such raids are contrary to humanitarian principles as embodied in the findings of the Hague convention. The Hague principles demand that war shall be waged with the least possible injury to non-combatants; and, to this end the convention prohibits the bombardment of undefended towns, and demands that where bombardment is undertaken due notice shall be given so as to enable the non-combatants to withdraw.

## The Shipping Bill Fallacy

ALTHOUGH the question of the upbuilding of our merchant marine and the scope and character of the governmental assistance which should be given to assist in its resuscitation is full of complexities, there is one fundamental fact in the situation which is clearly understood by the shipping men, by the private citizen, and even by Congress itself.

We refer to the fact that, because of the better food, better accommodations, higher pay, and other advantages conferred upon the American seamen by the navigation laws of the United States, the cost of running an American ocean-going steamship is so much greater than the cost of running a ship under a foreign flag, that successful competition in the deep-sea trade is an absolute impossibility.

Time was, moreover, when it cost very much more to build a ship in American yards than it did in foreign yards; but the margin of that difference has been gradually reduced, until now it is comparatively negligible in comparison with the vast difference in the cost of the operation of ships.

Everybody knows that we have failed to build up a modern merchant marine, and everybody knows just why we have failed. To-day the Government, with the strong backing of the President, recognizing the failure of private enterprise, wishes to go into the shipping business itself and fly its flag over a fleet of Government-owned ships, hoping thereby to build up an American merchant marine, and promising, when the new venture is fully established, to withdraw in favor of private operation and ownership.

We wish to put ourselves on record as stating, first, that the whole scheme bristles with fallacies; secondly, that the latest trade returns show that a Government-owned fleet is unnecessary; thirdly, that it will work injustice to the private owners of ocean-going ships; and, last and most important of all, that this shipping bill may well prove to be a snare which will sooner or later entangle us in the great European war.

In the first place, the Government is violating one of the fundamental, if unwritten, principles upon which government is based if it enters into a business enterprise in competition with the private interests of its citizens. Such action would be wrong in any case, and it is particularly vicious when the interests against which the Government will compete are already having the greatest difficulty in keeping their heads above water. It should be the policy of the Government to encourage our struggling merchant marine, not to drive it from the seven seas!

Furthermore, the plea of the President that the war has so disorganized the carrying trade that there are not enough ships to handle our imports and exports, has been completely demolished by the recent trade returns, which show an increase of exports for December, 1914, over those of December, 1913, of over $13,000,000. As we said at the outset, facts are what we should keep our eyes upon, not theories. And if ever cold, hard facts demolished a plausible theory, these trade returns for December have swept away the one plausible plea that has been made for this ill-conceived Government-ownership scheme.

Be it remembered, also, that in the very nature of things an enterprise which private capital and the best brains of the country have failed to make profitable can never be run at a profit if handled by the Government. Our humanitarian navigation laws render it certain that Government-owned fleets will be run at a loss. That loss must be made good from the Treasury, and to this extent the proposed Government-owned fleet will become a tax upon the people—a manifest injustice.

The last and, surely, the most important objection of all against this fatuous bill is the grave and ever-present danger which it will introduce in the international situation. The right of search on the high sea exists and is recognized; contraband of war is liable to find its way into the bottoms of ships, whatever flag they fly; and a situation is conceivable in which the right of search might be exercised on a ship that was sailing under the Government flag.

Is the Presidential hand which wrote the so-called "Declaration of Neutrality" prepared to sign a measure which might easily upset, in a single day, the neutral attitude which the President's proclamation has thus far so successfully assured?

## The Real Cause of the Italian Disaster

BURIED away in the many columns of news published during the past few days on the subject of the dreadful Italian earthquake is the following paragraph:

"Here and there throughout the devastated districts ones sees houses standing and apparently undamaged, although surrounded by the ruins of houses that were shaken into a mass of débris by the earthquake. These houses that remain standing are modern structures built of re-enforced concrete, and in the districts where the full force of the convulsion was felt they were about the only ones able to resist the disintegrating effects of the earthquake. The others, even when solidly built of stone, collapsed like so many houses of cards."

This paragraph, together with the fact, not stated but readily inferable from the above, that the occupants of these undamaged buildings suffered no injury from the earthquake, is quite the most significant thing that has been published about the disaster. It requires, however, some comment, because, standing alone, it might suggest the idea that re-enforced concrete is the only building material that insures safety from the effects of earthquakes, whereas, in fact, the mode of construction is a much more important factor of safety than the material.

An earthquake which, occurring in a region notoriously subject to seismic shocks, takes toll of thousands of lives and millions of dollars' worth of property is, at the present day, a stupendous anachronism. That earthquake disasters in such regions are almost wholly preventable is no new idea, yet so little is this fact taken to heart that again and again we are called upon to extend unqualified sympathy to a nation which is really suffering from the stupidity or indifference of the persons who control its destinies rather than from the malignant disposition of Mother Nature.

The art of earthquake-proof construction is no longer in its infancy. For at least twenty-five years it has occupied the attention of seismologists, architects, and engineers—in Japan, Italy, Austria, the United States, and elsewhere. We have not space here to present a *résumé* of this subject, but it is timely to quote a recent assertion of M. Montessus de Ballore—the foremost French seismologist—that the art has now reached such a degree of perfection that only a few minor details are still a subject of controversy. Briefly stated, the secret of making a building safe from earthquakes is to use sound materials in its construction and tie them together securely. According to the authority just quoted, at least four fifths of the damage wrought by earthquakes is due to the neglect of the ordinary requirements of sound construction—leaving the special dangers of earthquakes out of the question—while the remaining one fifth could be largely eliminated by an intelligent location of buildings with regard to known conditions of stability in the ground. The possibility of constructing buildings capable of withstanding even the most violent earthquake shocks is happily illustrated by the same writer in his comparison of an earthquake-proof building to a ship. Marine architecture takes account of shocks and vibrations altogether analogous to those occurring in an earthquake. A ship on dry land would not be injured by an earthquake, nor would her crew suffer any worse inconvenience than a possible breaking of tableware, such as may occur in a heavy sea.

After visiting the scene of the great Messina-Reggio earthquake in 1908, Prof. Omori expressed the opinion that out of every thousand persons killed in that worst of earthquake disasters, 998 must be regarded as victims of the faulty construction of houses. This opinion was based upon a comparison of the earthquake in question with that which visited the city of Nagoya, Japan, in 1891. The intensity of earthquake motion at Messina was slightly less than that at Nagoya; yet while only 190 people were killed out of a population of 165,339 in the Japanese city, there were 75,000 deaths in Messina, with a population of about 100,000. The Japanese buildings were designed to withstand earthquake shocks, while the Italians were not.

After the Messina earthquake regulations were laid down to insure a proper method of reconstructing the buildings, but it is understood that these regulations have not been adhered to, and hence the Sicilian town is likely to be the scene of another great disaster.

## Science

**The Collins-Day South American Expedition left this country at the end of December for a journey across** South America by way of La Paz, Cochabamba, and the Mamoré, Madeira, and Amazon Rivers. Besides exploring, this party will make extensive zoological collections for the Field Museum, of Chicago, and the American Museum of Natural History in New York.

**A New Capital for Nigeria.**—A recent change in the map of Africa was the amalgation of the former colonies of Northern and Southern Nigeria into the single colony of Nigeria. It is now announced that a capital of the newly constituted colony is to be built at Yaba, far in the interior, and at an elevation of over 2,000 feet. Although Yaba is not shown on any map to which we have access, it is evidently in the immediate vicinity of Zunguru, the present capital of Northern Nigeria, as it is described as being near the point where the railway crosses the Kaduna River. The climate is said to be dry, with comparatively cool nights during the greater part of the year.

**Rescue of Fishes from Overflowed Lands.**—One of the many interesting activities of the Bureau of Fisheries is the rescue of fishes from the temporary lakes and pools formed when the Mississippi River and its tributaries subside after the annual freshets. During the fiscal year 1914 about 2,500,000 fish of all species were saved, this number being about three times the collection of the previous year. All of these fishes would have perished from the drying or freezing of the ponds. Most of them were returned to the main streams, but certain species were used for pond-cultural operations and for stocking waters in other parts of the country.

**Valuable Gifts to Public Institutions.**—The will of Mrs. Henry Draper, widow of the noted astronomer and formerly professor of astronomy at Harvard College, which has recently been filed, has greatly benefited a number of public institutions. To Harvard University is given $150,000, to be called the Henry Draper Memorial Fund, the income of which is to be used in connection with the photographic work of the Draper Memorial. The university also gets all of the scientific apparatus that belonged to Professor or Mrs. Draper, and all of their photographic plates relating to astronomical subjects. The New York Public Library receives a bequest of $400,000, with a residuary bequest of $200,000 additional, and many articles of artistic, historical and scientific value are divided between the library, the American Museum of Natural History and the Metropolitan Museum. Bequests of $25,000 each are given to the Smithsonian Institution, the National Academy of Sciences, the Surgical Research Hospital of the New York University and a number of other institutions.

**Swimming Doves.**—A curious instance is reported by a correspondent of the excellent Dutch natural history magazine *De Levende Natuur*, of doves acquiring the alien art of swimming. The birds in question were ordinary domestic blue pigeons living in a dovecote beside his dwelling house near the water. "A few months ago," he says, "during a fight, a dove fell into the water and was rescued by human hands with some difficulty. Since that the doves are more familiar with the water, and yesterday I saw two sailing around on it like gulls. Tempted, apparently, by pieces of bread lying in the water, they had learned the art of swimming. When they had had enough of their bath they flew quietly out of the water." The writer, Mr. Noorduyn, insists there was no possibility of mistake as the birds were only 12 meters distant and his wife and daughter saw them also, while sitting at an open window, adding that he can tell a dove from a gull at 50 meters distance when sitting still and at 200 meters when flying.

**Sleeping Sickness**—Previous tentative statements in scientific literature as to the important differences between the so-called sleeping sickness of Nyasaland and Rhodesia on the one hand and that of Uganda on the other are fully confirmed by a recent report of the committee appointed by the British government to consider various questions connected with trypanosome infection and especially the advisability of destroying wild animals on a large scale as a means of checking the diseases of this class. The sleeping sickness of Nyasaland and Rhodesia is due to *Trypanosoma rhodesiense*, which is carried by the species of tsetse fly called *Glossina morsitans*; this disease is relatively uncommon among the native population and is not increasing, and there is no likelihood of its becoming epidemic. On the other hand, the form of sleeping sickness which has caused an enormous loss of life among the natives of Uganda is due to infection by *Trypanosoma gambiense*, introduced from the west coast of Africa by way of the Congo. It is transmitted by the tsetse fly known as *Glossina palpalis*. In this case man forms the most important reservoir for the disease, and wild animals apparently play a very small part in spreading it, though they may become infected. Domestic animals are a somewhat more active agency in spreading infection. The committee believes that game destruction in Uganda would probably have little effect on the disease, and that efforts should be concentrated on the extermination of the flies.

## Automobile

**New Cyclecar Has Five-cylinder Rotary Motor.**—Rotary motors have not been very successful in the automobile field, although they have proved efficient in aeroplanes. An exceedingly interesting motor of the rotary type is to form the power plant of a new cyclecar to be shown at the forthcoming Chicago automobile exhibition. The motor has 5 cylinders, and develops 12 horse-power at 1,400 revolutions per minute. It is said to be practically vibrationless, a demonstrating model being held on the knees of a workman while running at top speed.

**Carl Benz Celebrates 70th Birthday.**—Carl Benz, who with Gottlieb Daimler is usually considered the pioneer of the gasoline automobile, has just celebrated his 70th birthday. The marvelous growth of the automobile industry and the splendid work performed by the motor car in the present war were due in no small degree to Benz and his earliest "contraptions." His first car ran in 1885, while he filed a patent on it in January of 1886. Daimler invented independently a motor bicycle, which he completed in the fall of 1885. Neither of the two men knew of the other's work.

**Does Weight Increase Tire Pressure?**—That the pressure in an automobile tire, fully pumped up, remains practically the same whether the car is resting on the tires or is jacked up is the discovery made by one of the large rubber companies in an endeavor to solve some questions of "caring for tires while the car is laid up." It was found by means of special gauges that in an ordinary sized tire, which shows a pressure of 80 pounds while the car is jacked up, it will show 80.4 pounds with the weight of the car resting on the tires. The cubic contents are compressed by "flattening" from 900 cubic inches to 896 cubic inches.

**More Eight-cylinder Motors Announced.**—A veritable craze for 8-cylinder motors appears to have struck the public, if one would judge from the avalanche of 8-cylinder cars already announced and known to be "in the works." No less than fourteen were shown at the Chicago Automobile Show and several more manufacturers of motors have announced their intention of entering the field. There are grave doubts in the minds of many people in the industry whether or not this 8-cylinder "craze" will last. The ignition difficulties, especially in case of an interruption of current to the spark plugs, require expert diagnosis when befalling a complicated 8-cylinder machine with its multiplication of wiring.

**Twelve-cylinder Cars Coming.**—Although no definite announcements have been made as yet, and probably will not be made for a few weeks, it is well known that several makers contemplate bringing out a 12-cylinder model next year. The significant hint was given at an automobile dealers' dinner recently, in which it was stated that "if the public demanded a 12-cylinder car" this company was prepared to furnish it. The flexibility obtained with a many-cylindered motor is an inducement to many motorists to put up with many of its drawbacks and complexities. At the present time there is but a single 12-cylinder car made, the racing model of the "Sunbeam," a British make, which took part in the last Decoration Day races at Indianapolis.

**California has New Horse-power Formula.**—California motorists are up in arms over the new horse-power formula that is to be used in determining the power of their cars, for registration fees. The present so-called A. L. A. M. formula, in which the bore of the cylinder alone is taken into consideration, is of little practical value at the present time of long-stroke, small bore, high speed engines, and a motor rated at 18 or 20 according to this formula, would in reality develop more nearly 40 horse-power. The new California formula is as follows: HP= $0.224\ nD\ (D\ L)$, in which $n$ is the number of cylinders, $D$ the bore and $L$ the stroke in inches. In connection with this raising of the horse-power, for higher license fees, it may be stated here that not one motorist out of a thousand gets the actual maximum horse-power out of his car in ordinary driving; the low A. L. A. M. formula expresses about the power actually produced by the motor of an ordinary car on ordinary roads in the hands of the average driver.

**Portable Repair Shops for the War.**—So many motor vehicles are being utilized in the conduct of the war, and the service is so arduous, that it has been found necessary to provide some means for quick repairs, without the necessity of sending the car a long distance to some base far in the rear. To meet this demand several manufacturers in England have turned out traveling repair shops that can work right up to the front, and have done most valuable work in rescuing trucks that have met with some slight accident which temporarily put them out of action, and which in many cases would have resulted in their abandonment. A typical shop of this kind has a 3 horse-power gasoline engine which drives a dynamo that supplies lights for working at night, and also for a grinder and a portable drill. It also furnishes power for a 6-inch lathe that is provided with milling and other attachments, as well as screw cutting. The outfit includes a bench with a good vise, an anvil, forge and extensive assortment of tools, supplies and materials.

## Astronomy

**A Belgian Astronomical Journal,** viz., the *Gazette astronomique*, heretofore published monthly in Antwerp by the Société d'astronomie d'Anvers, will be published in London during the rest of the war, if efforts now being made to secure the necessary funds should prove successful.

**Proposed Solar Observatory in Kashmir.**—The government of India, which already maintains a solar physics observatory at Kodaikánal, near Madras, is now considering the plan of establishing one in the lofty valley of Kashmir. Mr. J. Evershed, director of the present observatory, spent several months in Kashmir, beginning April, 1914, and made a thorough test of the conditions for both visual and photographic observations. The results appear to show that Kashmir is a remarkably favorable location for solar observations, the atmospheric conditions being much better than at Kodaikánal.

**The Total Light of the Stars.**—Many estimates have been published on this subject. Newcomb estimated the light of all the stars down to the 9½ magnitude to be equal to that of 240 first magnitude stars, while Young estimated that the light from the stars of all magnitudes in both hemispheres might equal that of 3,000 first magnitude stars. The latest estimate, recently published by S. Chapman, is based upon the counts of stars on photographic plates, and is stated to be the equivalent of 690 stars of the first magnitude, according to the photographic standard, or from 900 to 1,000 first magnitude stars on the visual scale.

**The Observer's Handbook** of the Royal Astronomical Society of Canada has recently been issued for 1915, which is its seventh year of publication. This useful little manual is especially suited to the needs of amateur astronomers and is not so well known as it should be in the United States. Besides the ordinary ephemerides and almanac features, there are popularly written accounts of the astronomical sky for each month of the year, a series of outline star maps, descriptions of the constellations, with lists of celestial objects of interest to the owners of small telescopes, a section on meteors, and a variety of astronomical statistics, which are always kept well up to date. The society has its headquarters at 198 College Street, Toronto.

**Small Grants for Astronomical Research.**—"What use would you make of a grant for astronomical research of $1,000 a year for 5 years?" Prof. Edward C. Pickering has put this question to twelve prominent American astronomers, with the intention, after determining what needs can be met by such modest grants, of making an effort to secure the money. The answers to his question are summarized in *Science*, and it is interesting to find that it would take very little money—less, it may be noted, than the value of the ammunition used by a big siege-gun in the course of a day's firing—to put through several astronomical undertakings of great importance. Most of the astronomers questioned state that they would use all or a large part of the proposed grant in hiring assistants.

**A Brilliant Fireball.**—In Nature an interesting letter from Mr. W. F. Denning is published. He writes: "On November 11th, at 11.13 P. M., a magnificent meteor was seen from near Purley, Surrey, Stowmarket, Hornsey and other places. It looked like an unusually large ball from a Roman candle firework, and moved very slowly in the northeast sky, occupying about 6 seconds in an extended course. It was not a Leonid, but apparently from a radiant near $\alpha$ Lyrae in the northwest. The meteor illumined the sky vividly for several seconds, and was evidently rather near the earth's surface. From a preliminary discussion of the few descriptions already to hand it appears that the object fell from a height of 50 to 32 miles, and its velocity was about 11 miles a second. There was no known shower near Vega at the middle of November, but certain large meteors appear to be isolated. Some of the observers supposed it to have been one of the regular November meteors, but its direction was different and its speed altogether two slow for it to have been a Leonid.

**Colors of Stars.**—Prof. Barnard has investigated the colors of the stars forming the cluster M 13 in Hercules. When stars are too faint to be examined spectroscopically, an idea of their type of spectrum may be obtained from their observed color. In cases where the stars are so faint that they exhibit no color at all the photographic plate is called in. In the case of star clusters it is of great value to know whether the component stars are all of one spectral type or whether they show representatives of all types. In Prof. Barnard's investigation on the above-mentioned cluster the stars are practically divided into two color classes, blue stars and yellow stars, and this has been done by comparing two photographs of the same cluster taken under two conditions. One photograph, taken at the Potsdam Observatory, was taken in such optical conditions that the blue stars were relatively brighter than the yellow stars, while another photograph, taken at the Yerkes Observatory, was arranged so that the reverse should be the case. Prof. Barnard concludes that in this cluster there exist stars of extremely different types, and hence by inference, that there are stars of all the different spectral types.

# The Periscope—How It Is Constructed and Manipulated

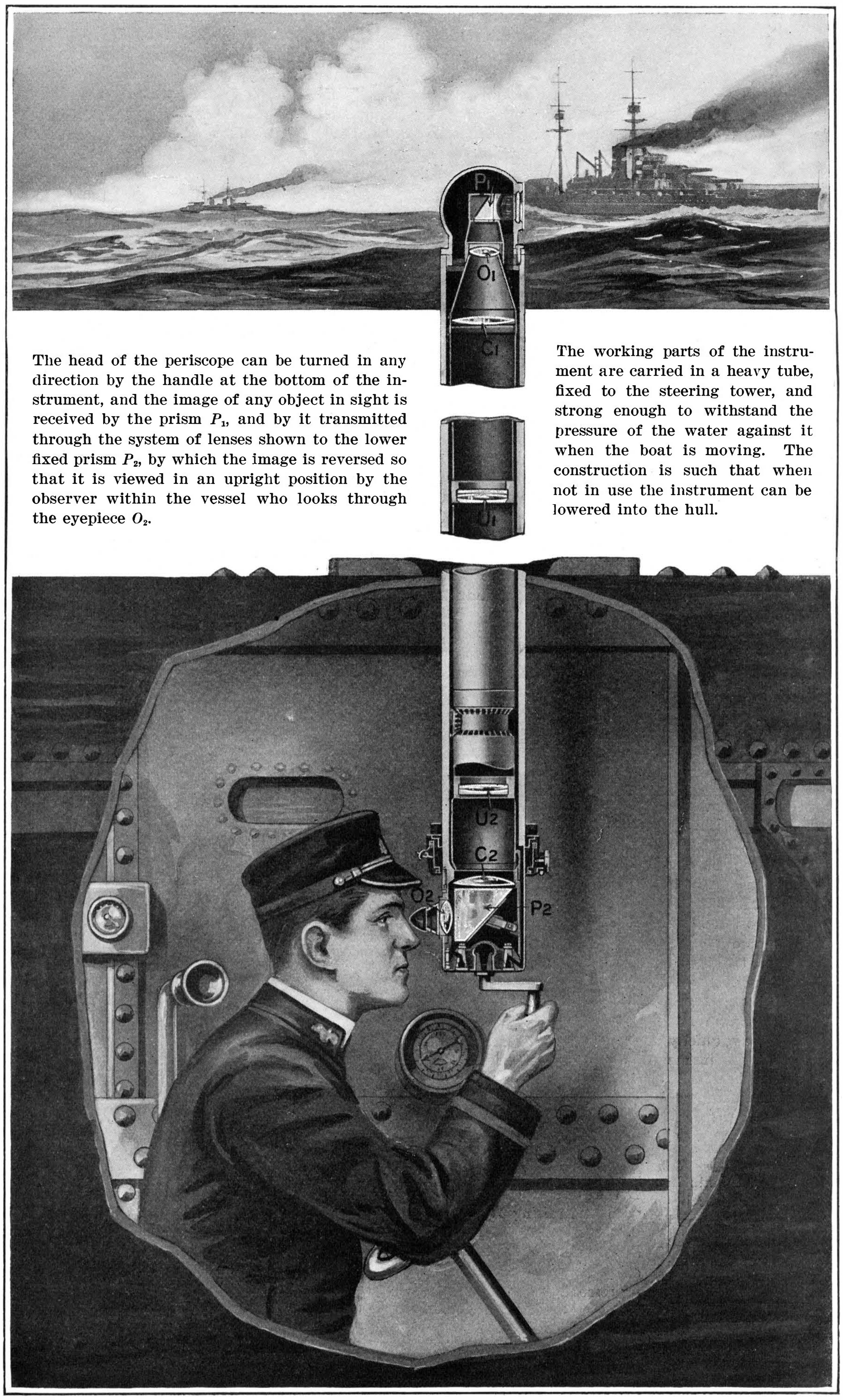
## The Searching Eye of the Submarine

THE mysterious and sensational performances of the foreign submarines have excited much wonderment in regard to how this stealthy scourge of the sea finds its way about under water, and locates its prey with such deadly certainty; and although pictures of this vessel, with its mast-like spying tube, the periscope, extending up from below to just above the surface of the water, are familiar, few realize the vital importance of this contrivance or the slow development that it has passed through before becoming the efficient piece of apparatus that it is to-day, and which is so essential to the successful prosecution of underwater attack. The power of the submarine is vested in its invisibility; but while the submarine is hidden from the enemy it must itself be able to see everything that is going on in order to solve its problems of offense and escape.

Something of the history of the periscope was told recently in the year book of the Schiffsbautechnischen Gesellschaft by Dr. Weichert, director of the Goertz optical works, from which publication the following facts are obtained. It is stated that the oldest known device for viewing objects from a concealed position was by means of a telescope with a doubly bent tube, which device was invented by Helvelius in the seventeenth century, and this may be regarded as the progenitor of the periscope. It may be noted that at long range this instrument gave a field almost too small for practical purposes.

The simplest sighting apparatus for submarines was invented in 1854, for it must be remembered that the work of experimenting on submarine vessels has been going on for a hundred and fifty years or more. This apparatus consisted only of a vertical tube that had a plane mirror set at each end at an inclination of 45 degrees from the perpendicular, and it contained the fundamental principle involved. In 1872 totally reflecting prisms were substituted for the reflecting mirrors, but in both of these forms it was necessary to use very short and wide tubes in order to cover a sufficiently wide field of view for working purposes.

The next step in the evolution of the periscope was to employ a system of lenses in connection with the prisms; and this construction is shown in the illustration, which, however, is of a later and much improved pattern. Following out the optical development of the instrument at this point, the question of the reversal of the image is provided for now by means of an "erecting prism," which is located near the lower end of the apparatus. As shown in the picture the part of the instrument tube that carries this erecting prism is connected by means of gears with the rotating top of the instrument, that carries the upper prism and the objective, in such a manner that the erecting prism turns with half the angular velocity of the top, which compensates for the difference of azimuth between the rotating upper prism and the lower fixed prism. As its name indicates this erecting prism reverses the image as it is projected through the instrument, and presents it to the observer in its natural position. In the earlier forms the instrument was in the form of a single long tube, and in order to allow it to be raised and lowered, and also turned in different directions, it was fitted in a water-tight stuffing box in the top of the steering tower; but it was found that the pressure of the water against the tube, when the vessel was moving, bent the tube backward to some extent and caused it to bind so tightly in the stuffing box that it was very difficult to turn it in order to make observations through any considerable angle; so an improved construction was devised in which the periscope tube proper was contained within a heavier fixed protecting tube or sheath within which the periscope turned. Further improvements resulted in a construction in which only the head of the instrument, carrying the upper prism, is revolved, the connection with the erecting prism below being retained.




The head of the periscope can be turned in any direction by the handle at the bottom of the instrument, and the image of any object in sight is received by the prism $P_1$, and by it transmitted through the system of lenses shown to the lower fixed prism $P_2$, by which the image is reversed so that it is viewed in an upright position by the observer within the vessel who looks through the eyepiece $O_2$.

The working parts of the instrument are carried in a heavy tube, fixed to the steering tower, and strong enough to withstand the pressure of the water against it when the boat is moving. The construction is such that when not in use the instrument can be lowered into the hull.

Redrawn for the *Scientific American* from *Umschau.*

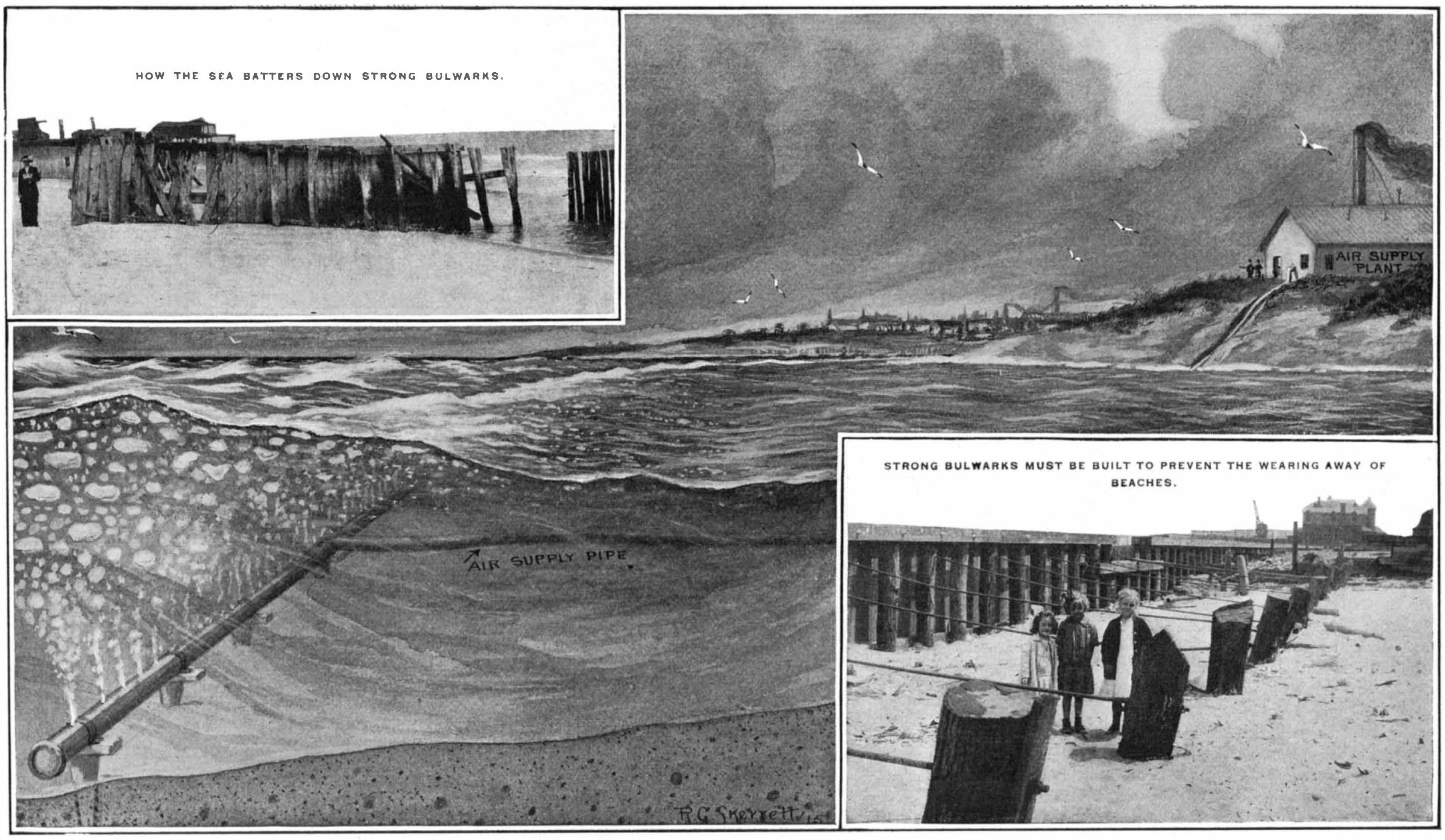
**The periscope. The eye of the submarine.**

To enable the vessel to be steered by the observations made by the periscope the officer in charge must have some means of knowing the exact relation of the line of sight of the instrument with the axis of the craft, and various devices have been employed for the purpose. In the earlier models this was accomplished by a mark on the tube and a graduated circle inscribed on the deck, and also by a second graduated circle and index inside the tube, and visible to the observer. A later system, adopted when the lower part of the tube is fixed, and the upper part movable, makes use of two glass plates within the tube. One of these plates is inscribed with a graduated circle and is attached to the fixed lower part of the tube, while the other plate bears an index mark and turns with the upper part of the tube.

The magnifying power usually found in these instruments is 1.5, but by the employment of special devices a power of from 5 to 6 magnifications can be secured temporarily. A more recent instrument contains a novel and valuable improvement that gives a sharp magnified image of the object sighted, surrounded by a view of the entire horizon on a smaller scale. This is accomplished by means of an annular lens that is located over the objective. Lenses of this sort were first employed in topographical work by Col. Mangin of the French army. Long continued observation with a periscope, using but a single eye, becomes fatiguing, and considerable relief can be secured by adjusting the instrument to throw the image onto a ground glass screen, where it can be viewed comfortably; but this plan can only be adopted in very clear weather, and even then the grain of the glass screen is liable to obscure distant objects.

The very latest designs have a compass, and a telemeter scale, by means of which the distance of the object can be determined, ingeniously combined with the periscope.

The development of the periscope has made the submarine practical, and indeed it is this very question of directing the movements of the vessel when under water that has been responsible for much of the delay that has occurred in the successful development of the submarine. That the problem has been quite successfully solved is apparent from recent performances in foreign waters, for it has been demonstrated that by the aid of the latest directional instruments the boat can dive below the surface when beyond the sight of an enemy, and easily find its way into the midst of hostile fleets, or into crowded harbors.




**By running a pipe out from the beach and blowing compressed air through it, wave action can be broken up and beaches saved.**

## Fighting the Sea With Compressed Air

By Robert G. Skerrett

SOME parts of our Atlantic sea coast are in grave danger because of the erosive action of storm-tossed seas. The beaches of New Jersey have suffered especially in this way, and the Federal Government is now studying the situation with an eye to evolving some sort of effective defense for the most exposed stretches of that littoral.

Wooden jetties and wooden bulkheads have been swept away time after time, and many thousands of dollars have been sacrificed in the building of ineffectual barriers. This situation inspired Mr. Philip Brasher, an engineer by profession, to devise a decidedly novel method of battling with the storm seas. In his invention again we see compressed air in a new service, for such is the medium that Mr. Brasher utilizes. He has aimed to sap the billows of their strength by assaulting them from below and from a point where his apparatus need not fear retaliation.

The surging sea is a grave menace only when it is about to curl over and break. At that moment, it undergoes a metamorphosis, "the oscillatory wave—one whose particles merely oscillate—becomes one whose particles travel along in a certain direction." Then it is that the entire mass, possibly representing many tons, instead of vibrating, advances bodily with the destructive momentum represented by such a bulk moving with speed. The shelving shore interferes with the vibratory translation and changes the rolling billows of the deep into the violent breakers that sweep up upon the slanting beach. As Mr. Brasher has reasoned it out, it would be possible to destroy the breakers by the theoretically simple procedure of disturbing the rhythm of the vibrating particles of water which transmit from one to the other the wave-making impulse. In other words, he would blanket or arrest this action by setting in motion a flow of particles directly across the path of the oncoming undulations, and thus interpose a barrier to further transmission of wave motion. Indeed, it might be better expressed as a gap of air bubbles supplanting the water particles normally present—a gap that would effectually bar further rhythmic oscillations.

In proof of this, it has been remarked in a well-known work on physics, that compressed air escaping to the surface of the river, during tunneling operations under the Hudson, created "a complete elevation of the water directly above the escaping columns and a tremendous disturbance of irregular bubbles. Waves which impinged on this disturbed area, collapsed like balloons which had been pricked with pins." Mr. Brasher has sought to improve upon this accidental action by distributing and controlling scientifically his flow of air. Forming, as he calls it, an "air breakwater."

To this end, he lays a long line of perforated 4-inch pipe on the water bed of the area to be protected and places this main at right angles to the sweep of the oncoming waves. A connecting branch, giving the system a T-shape, reaches shoreward, where it meets an air compressor of suitable capacity. According to Mr. Brasher, his air breakwater will make possible a number of marine operations which would either be seriously hampered or completely halted otherwise. "Dredgers can be kept working in the most exposed places during the roughest weather. The erection of permanent breakwaters, piers, lighthouses, and dams may be continued steadily, no matter what the weather conditions. Half-completed structures may be protected until completed. Lightships can ride out the roughest gale in an artificial lagoon of calm sea. Stranded vessels can be protected from the pounding of the waves until refloated." And, logically, exposed shore fronts can be similarly safeguarded against the sweep of stormy seas.

In view of what most of us know about the damaging and the well-nigh irresistible energy of tempest-bred waves, skepticism is not unpardonable, but those interested in this ingenious system declare that "the worth of the Brasher air breakwater is not a matter of conjecture. It has been proved practical and immensely valuable by actual tests. Mr. Moon, superintendent of the quarry at Crutch Island, Maine, where a trial plant was located, reports that on the day of the trial waves were rolling in so high that the spray was flying over the tops of the trees along the shore. Fifteen minutes after he turned on the air, Mr. Moon said he could paddle around in a canoe in the smooth water that the air breakwater furnished."

The question is, can Mr. Brasher's invention be applied to the New Jersey coast upon a scale ample enough to shield the areas that now suffer the most when a southeast storm blows? Will it be possible to furnish such a defense at a reasonable cost? To be effective there must be an abundance of air available, and air compressors of sufficient capacity to provide the needful supply would unquestionably demand a very heavy outlay. Finally, we ask, can the scale of the experimental plant at Crutch Island be taken as a guide for the application of this system to the more extended and possibly the more exacting situation to be met on the New Jersey coast? If it can, Mr. Brasher has opened the way for notable work in a number of coastal and salvage problems.

## Using Volcanic Steam for the Production of Electrical Energy

THE little city of Volterra, in northern Tuscany, is celebrated for its great salt wells and its extensive gypsum, marble and alabaster quarries. From Volterra a 90 minutes' automobile journey through a picturesque mountain region brings the traveler to Lardarello, the headquarters of the Societa Boracifera di Lardarello. The houses and the factory buildings are half hidden by clouds of sulphurous vapors, and the air smells strongly of hydrogen sulphide for miles around the village. This volcanic region contains many hot springs, *lagoni*, and numerous jets of steam, *soffioni*, which issue from holes and crevices at pressures up to 3.5 atmospheres and temperatures up to 400 deg. Cent. (752 deg. Fahr). Both the springs and the *soffioni* are impregnated with boric acid, which has been extracted from them, very easily and profitably, for a hundred years. It appears probable, however, that the heat contained in the *soffioni* will soon become more valuable than the boric acid.

The production of boric acid from the seventy natural springs and over 300 borings operated by the company is still carried on in a very simple manner. The water is conducted into large reservoirs, lined with masonry, where it is heated by injecting steam from the *soffioni*. The boric acid in the steam is thus added to that of the spring water. After 24 hours' heating and evaporation the water contains ½ per cent of boric acid. The steam is then cut off, the water is allowed to

By courtesy of *Prometheus.*

**Fig. 1.—Steam boiler heated by volcanic steam.**

settle and is then allowed to flow out slowly through a series of shallow leaden pans, which form a flight of steps about 8 feet wide and 400 feet long. The pans are heated below by *soffioni* steam—the only source of heat known in Lardarello. They are sheltered from rain by a primitive roof, but, as the air has free access at the sides, evaporation is so rapid that the solution leaves the last pan in crystallizable condition. After this solution has deposited its sediment in a steam-heated clarifying basin it is drawn off into lead-lined wooden vats, where it cools and crystallizes.

The boric acid thus obtained is not chemically pure. It contains ammonium sulphate and other impurities. Some of it is shipped in the crude state to borax factories. The remainder is purified by dissolving in hot water, adding nitric acid, expressing the mother liquor from the crystals formed on cooling, redissolving and recrystallizing. The pure crystals are dried, ground, sifted, and packed in boxes and casks, which are carried on Tuscan carts to the railway station at Volterra.

The steam from the *soffioni* serves not only as a source of boric acid and a source of heat for evaporating the spring water and drying the crystals, but also as a source of power for all the machinery. It is employed to operate low-pressure cylinder engines which drive the grinding mills, sifting machines, conveyers and hoists, the woodworking machinery for making boxes and casks, and a machine for rolling sheet lead, chiefly from old material. Another engine drives a dynamo which furnishes electric light for the factory buildings, the houses of the officials and workmen, and the castle of the Count of Lardarello. Finally, the natural steam is used exclusively for heating and cooking in Lardarello, which imports no coal or other fuel.

According to an article in *Prometheus*, from which we glean our facts, the steam is employed in a very wasteful fashion in the small non-condensing engines, some of which are of venerable age and leak atrociously, owing to the attrition of the mineral particles which the steam carries with it from the earth. But the steam costs nothing, and as it has been flowing in ever-increasing volume for a century, there is no fear of the supply's failing. "When we need steam we thrust a cane into the ground," the author of *Prometheus*' article was told. The problem is not quite as simple as this, but a copious outflow of steam can always be obtained by boring to a depth of 30 or 40 feet.

This inexhaustible supply of steam has recently led the company to utilize it on a larger scale for the production of electric energy, for which there is an extensive market in the nearby cities of Volterra, Siena and Livorno (Leghorn). For this purpose the low-pressure turbine, which has been developed so successfully in the past few years, seemed peculiarly appropriate. The natural steam, however, contains, in addition to boric acid and ammonia, from 4 to 5 per cent of carbon dioxide and smaller quantities of hydrogen and hydrogen sulphide. A low-pressure turbine using this steam would work with a poor vacuum and, therefore, very uneconomically, and it would also be rapidly destroyed by grit and other impurities. It was decided, therefore, to employ the natural steam as a source of heat for the production of pure steam for the turbines.

In order to test the feasibility of this plan the inclined water-tube boiler shown in Fig. 1 was constructed. A longitudinal vertical section of one of the four parts is shown in Fig. 2. The *soffioni* steam, entering at *A*, flows downward between the water-tubes, outward at *B*, and through the pipe *C* to the next section of the boiler. The water condensed from the natural steam escapes through an outlet at the lowest part of the bundle of tubes, while the gaseous impurities accompany the steam through the four sections of the boiler and are discharged into the atmosphere from the fourth section, with the uncondensed remnant of the steam, which has given up a large part of its heat to the pure water in the tubes. The feed water is pumped into the tubes through the inlet *F* and is kept at the level *a-b* by the regulator *E*. The water in the tubes is vaporized very rapidly and the mixture of steam and water is expelled violently from the upper ends of the tubes into the chamber *G*. The impact of the mixture upon the front wall of this chamber separates the steam from the water. The steam rises into the tubular steam chest *M*, which crosses all four sections of the boiler, while the water flows back through the return pipe below and rejoins the circulation in the tubes, as the arrows indicate. As the steam still contains some water it is not allowed to enter the turbine directly from the steam chest *M*, but is passed through a drying chamber (*S*, Fig. 1) very similar in construction to a boiler-section, where the remaining water is vaporized by the heat of natural steam.

The boiler has a total heating surface of nearly 1,100 square feet. It uses about 6,600 pounds of natural steam at 3.5 atmospheres pressure, and produces about 5,500 pounds of pure steam at 4 atmospheres (total) pressure per hour. The pure steam drives a 180-kilowatt low-pressure turbine, and is then condensed and returned, as feed water, to the boiler.

The results obtained with this experimental plant were so satisfactory that the company, after securing extensive contracts for furnishing current, decided to install three low-pressure turbines of 3,000 kilowatts power and 3,000 revolutions per minute. These turbines and the boilers required to operate them are now in process of construction, and a large area about Lardarello will soon be supplied with electric energy obtained from volcanic steam.

## Do You See the Point?

**By Dr. Leonard Keene Hirshberg, A.B., M.A., M.D. (Johns Hopkins)**

YOUR friend walks across the street. He slips upon a banana peel. He does not fall, but wobbles about perilously, juggling his tophat with one wild hand and the air with his other. You and everybody who witnesses his awkward embarrassment laugh aloud. Why? Have you ever stopped to consider it?

Frank Tinny, the great black-face comedian, and Julius Rannen, the side-splitting monologist, appear before the footlights, the one in absurdly informal regimentals, the other in a dignified dinner jacket. The whole audience sets its face in a smile or guffaws noisily before either has said a word. Do you know why?

A solemn wedding ceremony is in the process of being performed. The congregation are as silent as a desert. The turning of the page of the Bible by the clergyman sounds like cannonading by an 18-inch gun. Suddenly the officiating minister lays his hands upon the kneeling couple and absent-minededly reads, "O Lord, forgive them, for they know not what they do." A veritable pandemonium of half-suppressed merriment follows. Yet why is this pathetic mistake funny?

It is Christmas Eve. The snow falls and shoppers all hurry through the biting cold. Only a half-starved, half-naked ragamuffin lingers yearningly in the Arctic outdoors before a frosty bow-window in which are toys

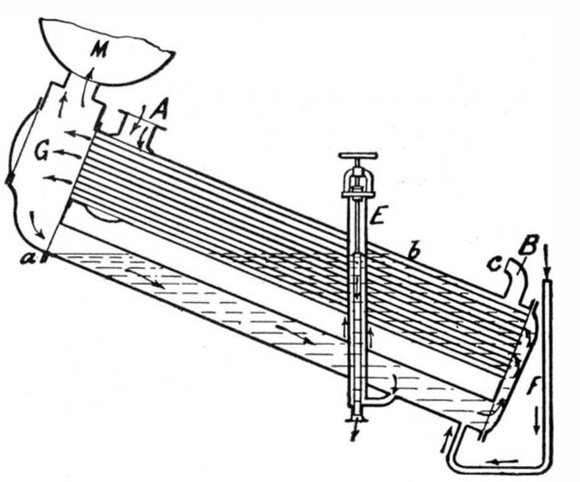



**Fig. 2.—Longitudinal section of one of the boiler sections.**

and Santa Claus. You see the longing and the poverty in his wan face. You do not know whether to cry or to smile. You may easily remind yourself of many other situations which have occurred to you that brought forth tears of laughter or tears of sympathy, you are not certain which.

Prof. Sigmund Freud, Prof. Henri Bergson, and Prof. John B. Watson of the Johns Hopkins University, as well as a number of other observers and experimenters, believe now, at last, that they "see the point" in the mysterious manifestations of merriment which all healthy persons enjoy. Everybody in every land boasts of his sense of humor, and no Englishman will admit that a modern major operation by Dr. Harvy Cushion, the brain surgeon, is necessary to get a joke into his head. Yet most Britons will tell you seriously that "some statements in George Bernard Shaw and Rabelais are incredible."

Such skeptics as Dr. Knight Dunlap, associate professor of experimental psychology at Johns Hopkins, say shyly that the men who have solved the *modus operandi* of human laughter perpetuated a perennial joke in their writings. Indeed, it is only owing to a lack of humor in philosophers that they take the works of Bergson, Lovejoy, Descartes, Kant, Hume, Hegel, and even Aristotle seriously.

It is according to the latest researches that abrupt discovery by one person, or rather the sudden feeling of vanity, of a sense of momentary supremacy, symmetry, and superiority in themselves over the individual or situation that is amusing, that causes the comedy. By habits, customs, superstitions, and prejudices most people have a standard of comparison to which all activities, behavior, and conduct must conform.

Any deviation from this normal form, if made slowly, gradually, and by things and persons that are honored and respected will pass muster without a smile. Even if a bit of behavior is done by one who is expected to do that particular thing, it will be watched and studied with attention. Thus, if a dancing master stands forth in an isolated position and performs a few strange gyrations, others round about will applaud and try to imitate him. If, however, a Methodist minister were to do exactly the same thing, not necessarily in his pulpit, but even in a dance hall, ribald laughter would be his just deserts.

A humorist always tries to destroy the logical sequence of words, events, and human behavior. The more the puritan loves symmetry, the more your merry Andrew hates it. The former bolsters up all perfection, the latter renders it ridiculous by a sudden termination of the correct proportions. The greater the contrast and unexpectedness in this artificial asymmetry, the funnier the result.

Superiority is a sensation that accompanies your recognition of an abruptly appearing inconsistency in form, word, action, or event. When Mrs. Malaprop says that the sight of the poor cat floundering about in hot grease was "heartrendering," your vanity is tickled to think that you know that the correct word is heartrending. This together with the asymmetry and inconsistency as well as contrast in the sentence, all stir your resibilities.

There is no true distinction, as some philosophic quibblers would have you believe, between wit, humor, slap-stick buffoonery, and Aristophanesian fun. All of them are based upon these same fundamental things, whereas one has to do with words. Another has to do with thoughts; while a third has to do with behavior, the fourth has to do with events.

Vanity,
Superiority,
Debasement,
Incongruity,
Asymmetry.

Sudden, emphatic contrast. It is all a mere matter of elementary addition. Even those instances of pathos that are upon the border-line of laughter and sorrow are linked closely together. For do not both of them stir you to tears? The warp of melancholy is intermingled with the woof of hilarity, and both weave a textile that covers the heart.

Nobody can have a real sense of humor who takes himself or life seriously. The first step toward the acquiring of the humor facility is to take an honest measure of your own unimportance in the world. Anthony Comstock, Emmeline Pankhurst, Barrett O'Hara, Charles F. Murphy, ex-Governor Sulzer, and Theodore Roosevelt would all have been more efficient and more true to the world and to themselves, if they were gifted with a better appreciation of their own plentiful lack of humor.

The Puritan conception of life, like that of vice-crusaders, suffragettes, and most crusaders, scorns all trifling with its weighty realities. Logic, symmetry, superstitions, and the human machine must never under any circumstances be interrupted from the even tenor of life's way. Neither Isaiah, the Athanasian, or any of the Old Testament contains humor, so then what right have you to laugh?

Unluckily for this type of militant morality, human nature will be forever human nature. So just as there is only one chemically pure vice-crusader in each ten thousand men, so there is only one man in ten thousand who is physically and morally able to keep his face eternally straight.

Humor, like the other sparks of the human soul, will out, and no anathema from Comstock or clergy will long suppress a Rabelair, a Swift, a Sterne, or a Judge. Jocosites are always strictly human, even when the wit is decorous. Gross incivilities, made palatable by fun, are like caviare to epicures. Your worst and most unfairly treated enemy can always be deprived of sympathy by wrapping your attack upon him in laugh-inspiring words.

If you would know, then, why a particular occurrence, phrase, situation, or bit of behavior stirs your midriff, pause calmly for a moment and honestly study your feelings. Your vanity will be given a shock, if Alexander Pope was right, when he said: "Gentle dullness ever loves a joke." This, however, is only part of the truth, for gentle wisdom and gentle education also love jokes.

To jest is human; to be serious, a crime!

---

**Zoline Fuel Had "Too Much Carbon."**—Zoline—the fuel that was to make motoring cheap, and that was to do all sorts of other things—is a thing of the past. At small expense a coterie of motor car manufacturers submitted the product and its inventor to a few rigid tests which proved it a failure. From a practical viewpoint the fuel would not work, because it persisted in crystallizing in cold weather, and even in moderately cool weather it would clog up the feed pipes. Chemists who have analyzed it say it has too much carbon, far more, in fact, than could be explained by the chemical constitution of the ingredients which the inventor said he used.

# Government Co-operation With Our Industries—I

## Why Foreign Markets are Closed to Us and How They May be Opened

*This is the first of a series of articles which the* Scientific American *intends to publish on our present industrial crisis and on the best methods of taking advantage of the commercial situation created by the war. Because Americans cannot possibly hope to succeed in entering foreign markets without first inquiring into the attitude of the Government toward industry in general, it seemed advisable to ascertain how far recent industrial legislation assists or arrests our export trade. Accordingly, this phase of the subject is taken up in the present article. The subsequent articles will indicate how far our own industries have been affected by the war, because they can no longer obtain from Europe the basic materials which they require, and how, by means of industrial research, they may render themselves independent of Europe, not only for the time being, but forever. The articles were prepared after many interviews with Governmental officials, prominent manufacturers, able lawyers, political economists, and industrial research scientists connected with private laboratories and our leading universities. For this reason the series may be regarded as a reflection of the best American political, legal, and scientific opinion on one of the most important problems which confront the American public to-day.*—Editor.

If the war will teach us the value of industrial research as an aid in the development of our industries, if it will induce manufacturers to engage technologists to devise processes for manufacturing the goods which hitherto they have purchased abroad, if it will open up foreign markets hitherto closed to us, it may prove a national benefaction. But unless the economic conditions are right it may not pay to spend millions in scientific investigation and in building factories. Economic conditions are, in part, controlled by governments, and it is the purpose of this article to discover whether or not our Government is enabling American capitalists to make the most of the opportunities created by the present conflict.

Perhaps the most conspicuous example of our apparent indifference to industrial research is to be found in the chemical industry—at least the newspapers told us so.

### What the Establishment of a Coal-tar Chemical Industry Means.

Since the American chemical industry has been more severely criticised than any other, we may well enter into a discussion of its difficulties, bearing in mind that they apply to a lesser degree to other manufacturing activities. There was a wild scurrying about for dyes and chemicals last August. Textile manufacturers bought all the colors that they could carry in stock, Certain chemicals, particularly some pharmaceutical products, were sold at a great advance over prices which, even in time of peace, were considered too high. The newspapers took up the question, and rather hysterically accused American chemists of incompetence. We had built up a great steel industry, a great machine tool industry, a great automobile industry. Why hadn't we built up a great chemical industry? Because Germany had a chemical monopoly, because the whole structure of modern organic industrial chemistry is German, it was thought that the German mind must be endowed with some magical power of penetration not given to the American, British, or French intellect.

The truth is that there is nothing the matter with the American intellect. We have no chemical industry and we are not likely to have one until the proper economic conditions are created by legislation. And that statement applies to other industries as well. Since the passage of anti-trust laws the prospects are gloomier than ever. The whole question has been argued back and forth in meetings of technical societies and in papers published in technical periodicals. Those who take a deeper interest in the subject should read the very detailed analysis which Dr. Bernhard C. Hesse made for the Board of Directors of the General Chemical Company, and the recommendations which the New York section of the American Chemical Society has made on the enlargement of the coal-tar chemical industry in this country. Both will be found in the *Journal of Industrial and Engineering Chemistry* for December, 1914.

As Dr. Hesse points out, the world's market in coal-tar dyes comprises about 900 distinct and different chemical substances, which are made by the aid of 300 products of transformation, themselves not dyes, often products obtained or obtainable from coal-tar by distillation, refrigeration, expression, or the like. No industry presents so many interlacing problems. Yet so thoroughly have the Germans done their work that in searching for new outlets only one unexplored field has been opened in the last ten years. In other words, all the pioneer research has been completed, and the task that remains is purely mercantile in character.

Dr. Hesse sums up the situation thus:

"Broadly speaking, all the rest of the world, outside of Germany, merely assembles intermediates purchased from Germany into finished dyes; Germany alone makes all its own intermediates; that is, Germany makes all the dye-parts and the rest of the world merely assembles these dye-parts into finished dyes. Needless to say, the one who controls the manufacture of dye-parts actually controls the manufacture of dyes.

"Where Austria, Belgium, France, Great Britain, Italy, Russia, and Switzerland singly and combined have failed, in spite of their other large chemical industries, to take away this business from Germany, the American chemist should not be blamed nor found fault with because he has not succeeded, nor should it be assumed that transplanting of the whole industry can be done at once and is a perfectly easy thing to do, as so many seem to think. The transplanting of that industry out of Germany is an undertaking properly and fitly to be described as titanic.

"Why the other countries have failed is probably due to the fact that they contributed little or nothing to the real upbuilding of the business, and to its creation, for the coal-tar dye business is a *created* business; those who aided in its creation were first in the position to reap the benefits—an advantage they have no doubt earned and deserved through the effort they expended and the risks they assumed."

### Why Government Co-operation is Necessary.

If this wonderful industry is to be established in this country it can only be with Governmental co-operation. An economic balance must be maintained, production must be carefully watched, wasteful competition must be checked, prices must be fixed by agreement on some products so that the whole enterprise may flourish. The slightest change from one of the operations may serve to upset this economic balance. In a word, only a trust with the power to control production and the market could establish a great coal-dye industry in America —the very piece of business machinery which is most abhorred in Washington. The huge chemical firms of Germany are knit together, more or less, in a combination which is able to dominate the markets of the world, and which exists not only with Governmental sanction and under Governmental control, but to a certain extent with Governmental encouragement. If we are to compete with Germany we must employ the same economic weapons.

The special committee appointed by the New York section of the American Chemical Society to study the chemical situation arrived at the conclusion that "alterations in our tariff law are inevitable" if we are to have a coal-tar chemical industry. The nation as a whole must bear the burden of expanding industrial chemistry in this country. Private capital can do no more than it has done. German plants cannot be valued exactly. They must be worth several hundred million dollars. Since they were built decades ago most of them have long since been paid for in profits. Couple to that financial advantage the permission to use such co-operative commercial devices as pools and selling agreements, and we need no longer wonder why, under present conditions, we are not likely to have a chemical industry comparable with that of Germany. A protective tariff would not place us altogether on a par with Germany; but it would at least make it profitable to engage in a few chemical activities.

We cite the coal-tar chemical industry because it is the most glaring example of the need of Government co-operation that we can find. The difficulties of establishing that industry are found in a lesser degree in other industries. But everywhere the German trust looms large.

### Trust-ridden Germany as an Invincible Competitor.

Even in the halcyon days of great combinations the United States was never so trust-ridden as Germany. At the present time there are more than one thousand trusts, "cartels" and syndicates, covering practically every line of business. Credits, prices, packing charges, sample shipments, these and many other things are regulated by cartels and conventions. The whole system smacks of the German army. It is organized efficiency pushed to the very limit. Needless to say, the German people relish these cartels, trusts, and syndicates no more than we relished our own combinations. But the German courts have viewed this crystallization of a nation's industry rather complacently on the whole, and the government assumes an attitude of encouragement, particularly when the competition of a foreign nation is felt. We saw that in the potash controversy. On the other hand, public opinion counts for more with trust magnates in Germany than it does here. To be regarded as an oppressor is not a social distinction; to be looked up to as a successful man—and success is measured in Germany by such titles as *Kommerzienrat*, or *Geheimrat, or Excellenz*, and by other honors which the various kingdoms, duchies, and principalities would hardly dare bestow on a commercial Tiberius—counts for more than millions. That is why greed is automatically restrained.

Germany owes her marvelous world-success in large measure to these permissive trusts. The great Westphalian Coal Syndicate, which controls practically the entire output of fuel in North Germany, has given English coal owners, struggling against one another for a bare existence, a taste of what a trust, backed by a government, can accomplish. The English mine owners care little what price they can obtain, so long as they maintain a full output. But the German collieries are in a working alliance that would be considered criminal in this country under the Sherman and Clayton laws. They distribute on fair lines the burden of loss or the balance of profit with due regard to the requirements of individual collieries. English coal operators have been forced into combinations to fight the German syndicate, for the sole purpose of supporting prices at a reasonable level. Beyond that they may not go. They can never hope to do more than avert heavy loss in bad times and earn a meager profit in good times.

Similarly, the great Steel Syndicate of Germany has pushed English steel makers to the wall. It decides what is to be sold inland and on what terms, and it fixes the quantities and prices of steel to be exported. Tariffs enable its members to command the home market. Thus it is possible to export the entire German surplus production at less than cost and tax the German consumer for the loss. German common iron bars are delivered and sold in Birmingham at $5 a ton less than it costs to produce them in Midland rolling mills. All this sounds very familiar to American ears. We rather plume ourselves that we have stopped a practice neither to be emulated nor encouraged, but that same practice must be reckoned with on entering foreign markets. We foresee the time when an international agreement must be arrived at by Germany and the United States in order that a code of commercial ethics may be framed, by the terms of which both Germans and Americans must abide. But until that millennium comes we must face the fact that the German trust exists, that it has the backing of its government, and that it has the power of dumping in any market which we seek to enter tons of goods which are not only normally cheap, but which are deliberately sold at less than our cost of manufacture until we are driven from the field. Protective tariffs alone will not help our home industries. Some form of "anti-dumping clause" is necessary, the framing of which will be a severe test of legislative ingenuity.

### The Futility of Half-way Measures.

How little even American business men realize the utter futility of establishing in this country industries which could not exist without permissive combinations may be seen from the report submitted last December by the special Committee on Trust Legislation to the Board of Directors of the Chamber of Commerce of the United States of America. Those who signed the report recommend the passage of a bill which would permit combinations entered into or carried on in good faith, for the sole purpose of increasing, facilitating or benefiting export trade. Such a bill would not be of much use in establishing a dyestuff industry, for example. It would be difficult indeed to imagine how the hundreds of by-products and intermediate products of the great German chemical industries could be successfully handled, both from a manufacturing and a commercial point of view, on any such basis as that proposed. The measure advocated seems intended to meet the competition which may be expected in foreign trade from a combination of buyers beyond the control of our Government—buyers who may dictate the prices at which American goods may be sold in foreign markets in the absence of authority to American manufacturers and exporters to co-operate to maintain prices abroad.

As matters now stand it is doubtful if, under the Clayton law, a group of competing American manufacturers could even engage a common selling agent to introduce their goods in foreign markets—so completely have we tied their hands.

Thanks to the Clayton law, still judicially unconstrued, our great manufacturing corporations may not legitimately use the powerful machinery of combination in their struggle for foreign recognition. A new enterprise which is to be conducted on the large scale

*(Concluded on page 108.)*

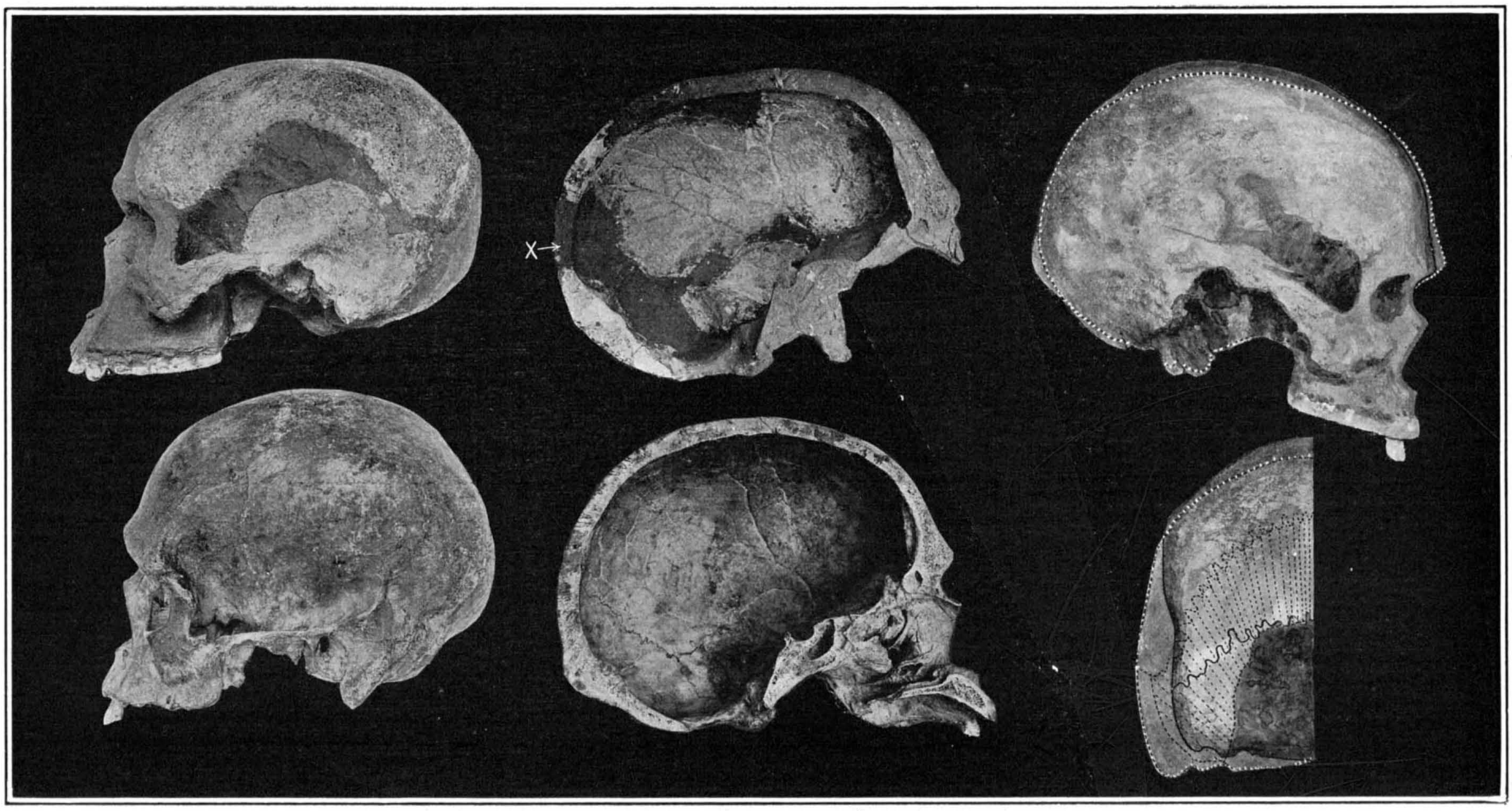


FIG. 1. (Upper).—Restoration of the Piltdown skull by W. P. Pycraft. The most conspicuous features of this aspect of the skull are the low dome, relatively slight development of the bony ridges over the eyes and the great length of the palate.

FIG. 2 (Lower).—Skull of an Australian aboriginal. In this the dome of the skull is seen to be much higher, the brow ridges larger and the palate shorter.

FIG. 3. (Upper).—Inside of the Piltdown skull, showing contact between the squamosal, or temporal bone, and the parietal, marked, and the low floor of the fore part of the brain case. The slope of this floor should be compared with that of the Australian aboriginal, shown in Fig. 4. Note the unusual thickness of the skull wall.

FIG. 4. (Lower).—Inside of skull of an Australian aboriginal, showing comparatively large brain cavity.

FIG. 5. (Upper).—Superimposed outlines of the Piltdown skull and that of an Australian aboriginal, bringing out characteristics shown in Figs. 1 and 2.

FIG. 6 (Lower).—Superimposed contours of the left half of the back of the Piltdown skull and that of the Australian aboriginal. Note the enormous width across the base of the Piltdown skull. The dark shaded areas in all the figures of the Piltdown skull represent restored portions.

**Details of the Piltdown skull, and comparisons with skull of an Australian aboriginal.**

# Mankind in the Making

## The Direct Ancestor of the Modern Man and What He Looked Like

### By Prof. W. P. Pycraft, British Museum, London

THE history of mankind in the making is still far from complete, and this is especially so in regard to its early chapters. Most of what we have gleaned on this head is in the nature of inference, drawn from the rude stone weapons which have survived him, leaving no trace of their makers.

The discovery of the now famous fragments of an indubitably human skull at Piltdown, in Sussex, which was first announced at a meeting of the Geological Society of London, December 18th, 1912, was, therefore, an event of epoch-making importance, for not only was it found in association with rude stone weapons of the type known as "eoliths," and with remains of animals of older types than any hitherto associated with early man, but it displayed features more primitive, more ape-like, than any yet discovered. Quite recently a further find has been made of a crude sort of spear-head, made from the thigh-bone of an elephant. This was obtained from the same area as the skull itself, and from its highly mineralized condition there can be little doubt that this was wielded by the Piltdown man, or his contemporaries. Since the precise geological age of this skull is still a matter for debate—as to whether it is to be regarded as of very late pliocene or early pleistocene—it will be more profitable to discuss in these pages those features of the skull itself which have made it of such supreme importance as a "missing link" in the chain we are endeavoring to forge.

These bones of contention, for such they speedily became, represent the roof and back of the skull, the temporal bone, with the great triangular beam lodging the internal ear, and, externally, a part of the bony arch which runs forward to the eye, and last, but by no means least, the lower jaw, or rather the right half, containing two molar teeth. Later a relatively huge canine turned up, of which more anon.

As Dr. Smith Woodward pertinently remarks, when it is remembered that *Eoanthropus Dawsoni* and *Homo Heidelbergensis* are almost, if not absolutely, of the same geological age, we are led to the interesting conclusion that at the end of the Pliocene Epoch the representatives of man in Western Europe were already differentiated into widely divergent groups.

This skull is no less remarkable when compared with the other undoubtedly ancient human skulls, and suggests conclusions of even wider significance. The discoveries of the brain-case of that curiously ape-like man, Pithecanthropus, in Java, some years ago, and of several of the skulls of the Mousterian or Neanderthal type, have led to the assumption that early man was characterized by a low, flattened forehead, and a beetling brow, like that of adult existing apes. But the Piltdown specimen, Dr. Smith Woodward points out, is certainly the oldest typically human skull yet found, yet it has a forehead as steep as modern man, and by no means conspicuous brow-ridges. This latter fact has led to the suggestion that this skull is that of a female, and the small backward extension of the area for the masticating muscles is held to be an additional index supporting this conclusion. This, of course, may be so; but on the other hand we have to take into consideration the enormous thickness of the skull wall, which by the way goes far to account for the small size of the brain.

All the evidence goes to show then, that at least one type of man with a high forehead was already in existence in Western Europe long before Mousterian man. It is curious to remark, however, that this ape-browed man had a larger brain than the Piltdown man. This apparent discrepancy is explained by the almost inevitable conclusion that the Piltdown man is the direct ancestor of modern man, while the Mousterian or Neanderthal man was an offshoot from this stock. In regard to the base there are one or two features of quite exceptional interest. In the first place the width exceeds that of any modern skull so far measured by some 20 millimeters (Fig. 6). So wide a difference indicated either an error in the work of reconstruction or some structural peculiarity so far unsuspected. Having carefully considered the problem in the course of a restoration I had undertaken to check, as it were, the results of Dr. A. Smith Woodward, I came to the conclusion that some structural peculiarity was to be sought for, and this I speedily found in the exceptional length of the petrous bone, which proves to be no less than 10 millimeters longer than in any modern skull. Thus adding this increase of the two sides together the abnormal width was exactly accounted for. This increase has been accomplished by a curious change in the parietal region of the skull for the hinder and lower border of this region, somewhere about the level of the top of the ear, and a little behind it in the living subject, has been thrust outward. Hence the striking difference between the Piltdown and modern skulls when seen from behind, as in illustration (Fig. 5), for in the modern skull the widest part is seen to be high above the base.

The restoration which I undertook was the first to effect a reconstruction of the floor of the brain-case, and to show the position of the nerve apertures and the apertures for the blood vessels; and from the interior of this it has been possible to take a fairly accurate cast of the brain cavity, and especially of the base of the brain. In attacking this problem I may mention that this building up of the skull base formed the foundation of my restoration. This completed, the remaining portions of the skull were fitted on to it. The result was a skull differing only in minute details from the original restoration of Dr. A. Smith Woodward, which, according to some, and especially Prof. Keith, was too absurd to be seriously considered.

The most conspicuous feature of this skull, when seen from the side, is the low roof or dome and the slight development of the brow-ridges. The latter feature is brought even more forcibly home when the skull is seen from the front, or from above. This is really surprising, for these ridges in the earliest fossil, men known as the Neanderthal men, are enormously developed, recalling those of the great apes, such as the gorilla and the chimpanzee. In the Piltdown they are less conspicuous than in many savage races of to-day.

The face must have presented an extremely ape-like appearance, owing to the enormous size of the jaws. The nasal bones, however, were negroid, not ape-like. The really ape-like characters are concentrated in the lower jaw. So much so is this the case that there are some who have gone to ridiculous lengths to show that this was really that of an ape, and had nothing to do with the skull. Needless to say such opinions were expressed only by those unfamiliar with the problems of comparative anatomy, and palaeontology.

That this jaw did belong to this skull is not a matter for dispute. Its Simian features should not occasion surprise, having regard to the age of the skull, and the relatively small size of the brain. Compared with that of a modern European its most striking feature is the absence of a "chin," that is to say of the projection of its lower border, which in modern skulls protrudes

beyond the level of the cutting teeth, or "incisors." In this, however, it agrees with the jaw found some years ago at Heidelberg and known in consequence as the "Heidelberg jaw." About the human nature of this there is no doubt, for the character of the teeth renders any other interpretation impossible.

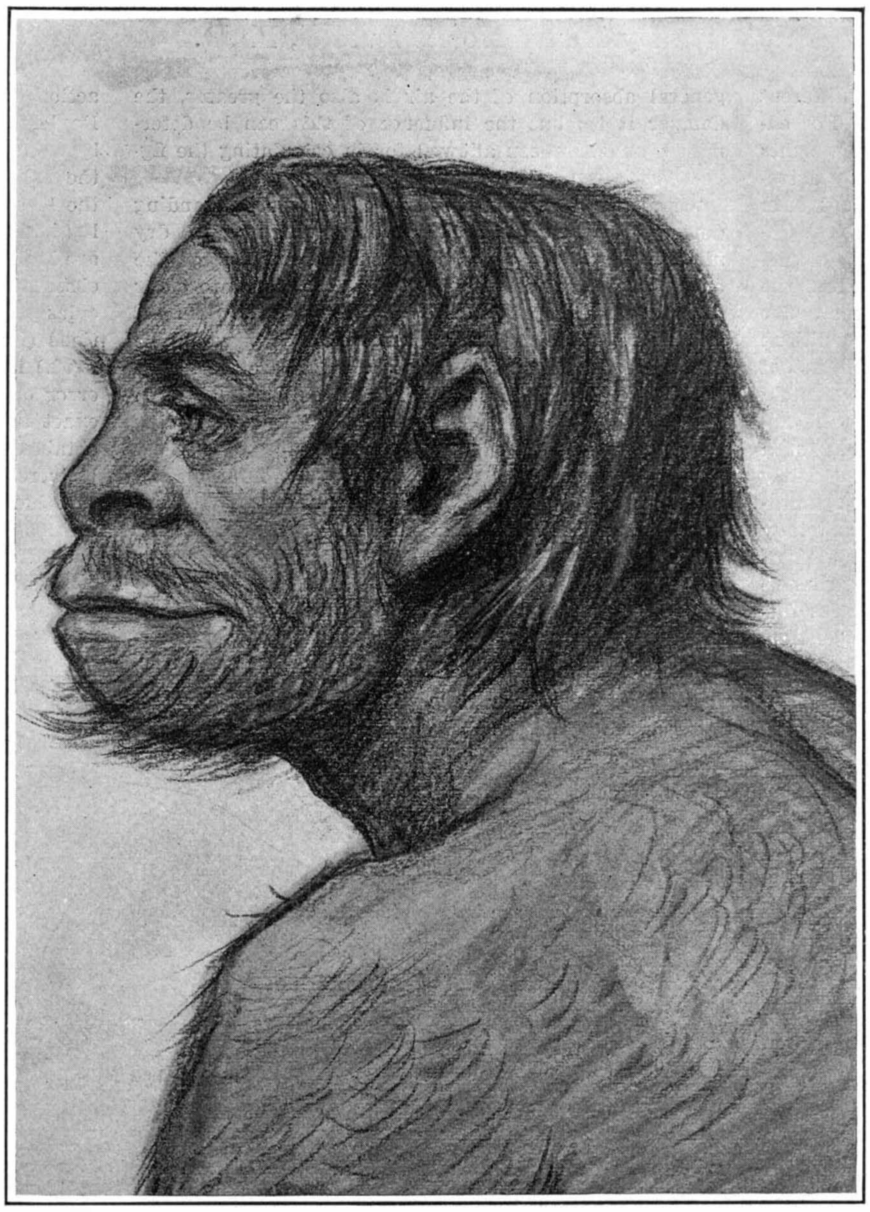
Omitting reference to many other somewhat technical details presented by the Piltdown jaw we may turn now to the teeth. The Simian, or ape-like characters of these is very striking, both in regard to their shape, and their arrangement in the jaw. As in the ape the cheek-teeth or molars, and pre-molars, are placed in a straight line one behind the other instead of in a curve, as in modern human jaws. When the jaw was first found the pre-molars, canine, or "eye-teeth" and the cutting or incisor teeth were missing. Nevertheless, Dr. Smith Woodward, in his restoration ventured to introduce a large canine. The critics scoffed, and pointed out the absurdity of such a venture. Unfortunately for them the missing tooth turned up shortly after. Attempts were then made to show that it could not have belonged to this jaw; but a more careful study of the find seems to have convinced them that they were hopelessly wrong in their pronouncements. But whether or no there can be no doubt but that it is one of the missing series. And the most wonderful thing of all is that, when this tooth came to be compared with the tooth postulated by Dr. Smith Woodward, it was found to differ only in minute details. It differs absolutely from the canine of any known ape, and no less from that of any human tooth yet found known. In some respects it recalls the canine of the milk series, which is what one would expect.

While the skull is essentially human, that is to say, it is the skull of a member of the genus Homo, though representing a man of low grade, the jaw, on the other hand, as we have already remarked, is almost that of an ape. On this account these remains must be regarded as representing a new genus of mankind which Dr. Smith Woodward has named Eoanthropus. Or to give it its full name Eoanthropus Dawsoni, in honor of Mr. Charles Dawson who discovered the first of the fragments.

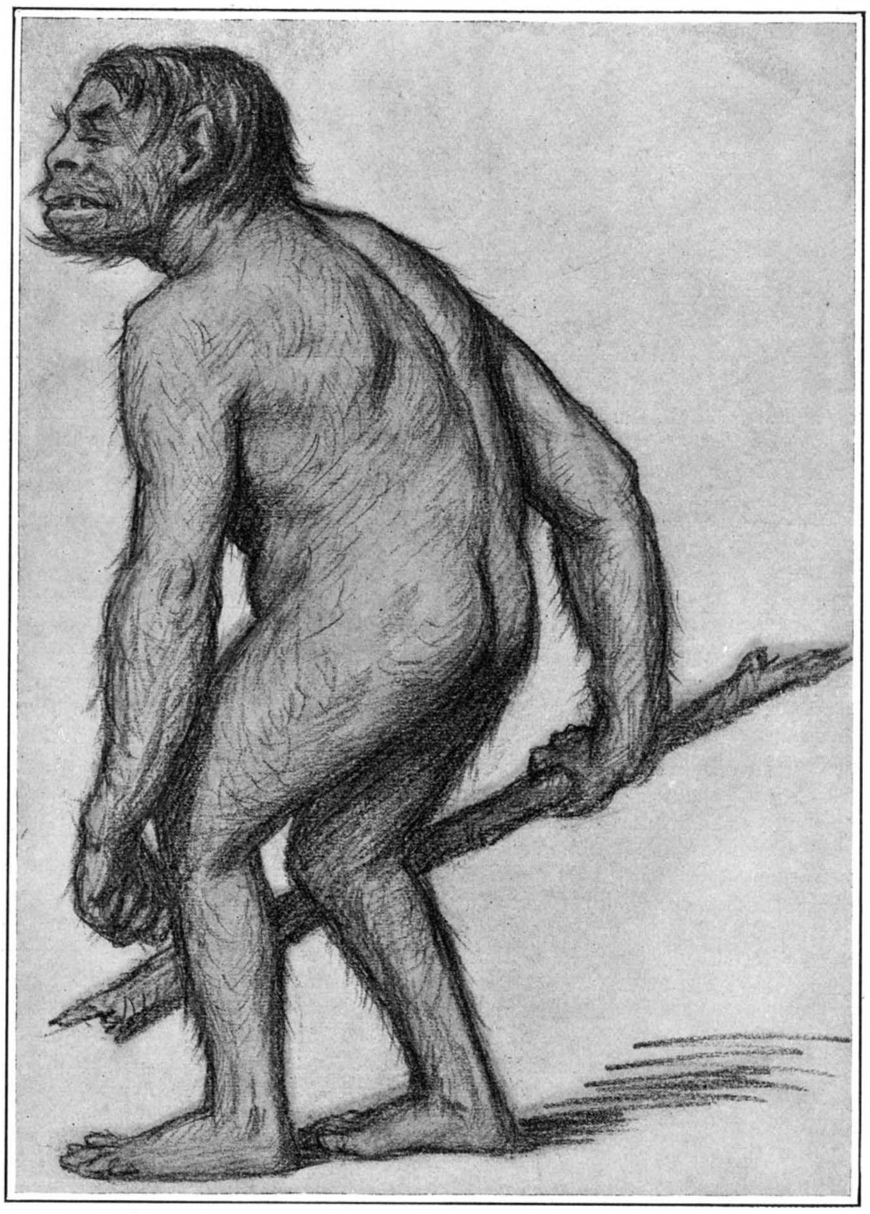
The form of the roof of the skull, of the brow-ridges, and of the temporal-bone admit of no doubt as to the human character of these remains. What is known as the petrous portion of the last named bone, and the nature of the articular cavity of the lower jaw, differ only in minute points from the same areas in modern men.

No estimate as to the form of the skull, and the cranial, that is to say the brain, capacity of this skull could, of course, be made until the remains were pieced together. Toward the fulfilment of this task certain fixed points were at once available. Thus the frontal bone retained a portion of the outer border of the eye-socket, while the hinder portion of this skull-cap could be positively connected with the bones forming the back of the skull, this gave the approximate length of the cranium. There was another actual point of contact with the temporal bone and the parietal (Fig. 3). This enabled a fairly accurate estimate to be made of the height of the skull. Its width, a measurement of great importance, has formed the subject of much controversy, though as a matter of fact, there can be little room for doubt even on this head. Much depends on the correctness as to the exact position of the middle line of the skull-cap. That this has been fixed by Dr. A. Smith Woodward and Prof. Elliot Smith there can be no question, but Prof. Keith, of the Royal College of Surgeons, insists that this line has been placed too far to the left, thereby materially lessening the size of the brain case, and, as a consequence, the size of the brain, which he assures us exceeded that of modern white races of to-day. That there is absolutely no evidence to support this view we have no hesitation in saying.

The critics indeed have been singularly unfortunate, so far, in their pronouncements on this restoration. According to them, this skull is much too narrow across the roof, and much too wide across the base. As touching the roof enough, for the moment at any rate, has already been said.


Drawn for the *Scientific American* by J. Cooke.

**Head of Piltdown man.**


Drawn for the *Scientific American* by J. Cooke.

**The Piltdown man (Eoanthropus Dawsoni).**

## New Lens Gives Clear Vision

What was done for the photographic lens some twenty years ago has just been accomplished for the ordinary eye-glass or spectacle lens; that is, it has been corrected for astigmatism through its entire field. It is true that in the case of the photographic lens the result was accomplished by combining several layers of different kinds of glass, which could not be done with a spectacle lens; still it must be considered remarkable that when we consider how vastly the users of spectacle lenses outnumber those who require a photographic lens more effort was not made to perfect what may be called the every-day lens.

With the old style flat lenses a field of view of but 16 degrees was afforded, and if the eye was turned in its socket in any direction the image which it saw was blurred and distorted to such an extent as to be generally undistinguishable, and this made it necessary for the wearer to turn his head from one side to the other as he read a line of print. This, however, is not an operation that ever becomes really natural, and the wearer of glasses is constantly turning his eyes, and with the result that he strains the eye in endeavoring to distinguish the blurred forms seen through the side portions of the lenses. Later on an improved lens, the "toric," was introduced which, for most classes of lenses, enlarged the field to about 52 degrees, and it seemed almost as accepted that this was the limit of improvement possible. For some years, however, the work of designing an ordinary single-piece lens in which all astigmatism and distortion of the oblique rays would be eliminated has been going on at the laboratories of the Carl Zeiss works, at Jena, Germany, and as a result, Dr. Moritz von Rohr of the scientific staff has produced a spectacle lens which has been named the "Punktal" lens that gives a field of vision of 80 degrees entirely free from astigmatism. Much as wearers of glasses appreciate the annoyances and imperfections of the present lenses it will be difficult to understand the comfort and relief afforded by the new Punktal lenses until they are tried practically as practical comparison seems to be the only means of judging. The right to manufacture the new lens is held by the Bausch & Lomb Optical Company, the American associates of Carl Zeiss and among the instigators in its development.

## The Detoxication of Tobacco

Innumerable attempts have been made to protect smokers from the harmful effects of nicotine. So far, however, this object has not been achieved without at the same time depriving the tobacco of its aroma and taste. Recently Ambialet, a French physician, read a paper before the Medical Society of the Department of the Rhône on one of these attempts. His plan is to do away with the defects of other remedies, and it deserves publication, particularly because of its simplicity. Dr. Ambialet has found that if the ordinary coltsfoot or butterbur, which is very common in the countryside, is mixed with tobacco the harmful effects of the latter are completely eliminated. He has himself smoked daily some forty cigarettes made of this mixture, without feeling the slightest effect from the nicotine. At any rate the remedy may be worth a trial, coltsfoot leaves being perfectly harmless and cheap.

Dr. Ambialet claims that tobacco mixed with coltsfoot leaves retains its full aroma and taste, the only perceptible change, if any, being an additional flavor like that of Turkish tobacco. This added flavor should render the mixture very acceptable to most smokers.

---

**Plastering by Machine.**—A plastering machine forms the subject of patent, No. 1,100,565, to A. G. Higgins, Kansas City, Mo., assignor of one half to R. M. Havens, same place, and provides means by which cement or other plastic composition may be mixed and fed on to the surface of a trowel so it may be spread upon a wall.

# The Heavens in February

## Determining the Weights of Molecules and Atoms by Astronomical Observations

By Henry Norris Russell, Ph.D.

THE connection of investigations in different branches of science is often very curious. For example, no one would suppose off-hand that the weights of molecules and atoms could be determined by astronomical observations; but exactly this has just been done in a paper by Mr. Fowle of the Astrophysical Observatory of the Smithsonian Institution.

Strictly speaking, the quantity determined from the Smithsonian observations is the number of molecules in a cubic centimeter of air under standard conditions of pressure and temperature, from which the actual weight of these and other molecules can immediately be deduced. This fundamental physical constant appears in the astronomical work as a by-product of a by-product, but its determination is, nevertheless, fairly precise. The main object of the work of the Smithsonian observers has for many years been the study of the Sun's radiation. The amount of absorption of solar radiation in the Earth's atmosphere has incidentally to be determined, and the variation of this for different kinds of light gives the constant in question.

It is an easy enough matter, with modern measuring instruments, to determine how much energy is carried by a beam of sunlight of known cross-section, as we receive it at the Earth's surface. But this amount varies from day to day, with the clearness of the air, and from hour to hour, with the altitude of the Sun and the length of the path which its rays traverse in our atmosphere; and to correct for this and deduce how much energy the measuring apparatus would have received per minute if it had been situated outside our atmosphere, is a difficult problem.

If all the solar energy were carried by radiation of a single kind (of a definite wave-length) the calculation would be fairly simple. Suppose that, at noon, with the Sun at its highest in the sky, our atmosphere lets 90 per cent of the energy of the radiation get through to the Earth's surface. A second layer of air of equal thickness would transmit 90 per cent of the energy which got through the first layer. But we can actually obtain such a double layer by observing at a time (in the morning or afternoon) when the Sun is at such an altitude that its rays have to traverse twice as long a path through our atmosphere as at noon. The energy which we would receive outside the atmosphere will then be greater than that measured at noon in the same proportion in which this exceeds the amount measured at the morning observation. In practice any two observations at different altitudes of the Sun can be used, for the "air mass" along the path of the rays can always be calculated. What complicates the actual problem is that the amount of absorption, for the same thickness of air, varies very greatly for radiation of different wave-lengths. It is, therefore, necessary to split up the solar radiation by means of a spectroscope, determine the amount of energy caused by radiation of each wave-length and apply the process just sketched to each separately, adding the results at the end to get the whole solar radiation.

As an incident in this laborious but unavoidable process, it is clear that the computer will obtain values for the transmission of radiation of different wave-lengths through the Earth's atmosphere, which may easily be reduced to the amounts which would be found for rays coming vertically downward along the shortest possible path. As might be expected, the atmospheric transmission is much diminished by any perceptible haziness of the sky, and good sets of observations can only be obtained on clear days. But, even in the clearest weather, and at high mountain stations, there is a very perceptible loss of energy in passing through the air, and the percentage of loss increases steadily as the wave-length of the radiation becomes smaller. Under favorable conditions at Mount Wilson almost 99 per cent of the infra-red radiation of long wave-length gets through the air. In the green part of the spectrum the percentage transmitted drops to 90, in the violet to 80, and in the ultra-violet only a little way beyond the limit of easy visibility to 60.

In certain regions in the infra-red, the atmosphere is almost opaque to solar radition, owing to "selective absorption" by the water vapor present in it; and the general absorption of the air is also the greater, the damper it is; but the influence of this can be determined, and has been allowed for in calculating the figures just given.

There is good reason to believe that the outstanding depletion of the solar radiation on passing through dry air arises mainly, not from actual absorption of the energy, but from scattering of the radiation into other directions than that of the direct rays of the Sun. If this did not occur the sky on a clear day would be black except for whatever whitish dust-haze might appear in it. The familiar blue color, as Lord Rayleigh has shown, is a direct consequence of this scattering of light, which is produced, even in perfectly dust-free air, by the gas molecules themselves. These minute bodies act far more powerfully on radiation of short wave-lengths than on that whose waves are longer; indeed, the scattering power for violet light is ten times that for light in the extreme red. Hence, the air molecules diffuse a far larger proportion of blue and violet light than of red and yellow, and the sky looks blue. Dust particles, on the other hand, reflect light of all colors equally, so when the air is full of dust or haze and the sky is brighter than usual, the blue is mixed with white, and the sky becomes milky; while on the clearest days the sky is the deepest blue.

The light which goes to make the sky blue is taken from the direct sunbeams, and, therefore, when the Sun is near the horizon, and the path of its rays through the air is long, very little blue light is left to get to us, and the Sun looks yellow or even red, whence the familiar sunset coloring.

We may, therefore, split up the general absorption of light by the air into two parts, one depending upon the presence of suspended particles of dust or fog, and the same for all kinds of light, the other depending on scattering of light by the molecules themselves, and varying as Rayleigh has shown, inversely as the fourth power of the wave-length. From a study of the Mount Wilson observations, Fowle concludes that the influence of dust or haze on the average clear day is practically negligible, the absorption due to this cause being but 1/200 of the amount transmitted.

This statement applies only to normal conditions. In 1912 the upper air was so full of fine volcanic dust from the great eruption of Mount Katmai in the Aleutian Islands that the observations of its transmission could not be used for the present purpose, and even in 1913, when the dust had had a year to settle, enough remained to produce an absorption of 2½ per cent of the incident radiation—fully five times the normal value.

Almost everything that is observed is due to the action of the molecules of the air. Now, according to Rayleigh's theory, there exists a fairly simple relation between the amount of this molecular scattering and the number of molecules per cubic centimeter, so that the last can be calculated, if the length of path of the light in the gas and the refractive index of the latter are known. Applying this formula to the Mount Wilson observations, Fowle concludes that the number of molecules per cubic centimeter of air, under standard conditions (barometer 76 centimeters and temperature 0 deg. Cent.) is 27 billion billion ($27.04 \times 10^{18}$) with a probable error of less than one per cent. This is in practically exact agreement with the very precise value recently obtained in quite another way by Prof. Millikan of the University of Chicago, and in harmony also with that of other observers who have used absolutely different methods of investigation. Now, according to fundamental chemical principles, the number of molecules in a cubic centimeter of all gases, under the standard conditions, is the same. Moreover, it takes 11,200 cubic centimeters of hydrogen to weigh a gramme. Hence we find that in a gramme of hydrogen there are 303 thousand billions of billions of molecules and twice as many hydrogen atoms ($6.05 \times 10^{23}$), and, since the relative weights of the atoms of the various elements have been determined very precisely by chemical means we are in a position to state the actual weight of a single atom or molecule of any substance of known chemical constitution.

A conclusion of more astronomical importance is that it is impossible to find clearer skies than exist at the best observing stations, unless by going to very high altitudes. More remarkable is the deduction that a ball of perfectly clear air as big as the Earth (if it could be kept of uniform density throughout) would be quite opaque. Yellowish-green light, the kind to which the human eye is most sensitive, loses 10 per cent in passing through the air above Mount Wilson (equal to about four miles of air at standard pressure and temperature).

Only 35 per cent of such light would get through 100 miles of air under standard conditions, even if the air was absolutely free from dust and haze, which evidently explains why distant mountains, even in the clearest weather, look blue, for at least two thirds of the light we get in looking at them is blue-sky-light from the air in front of them.

A thickness of 500 miles of air would transmit only 1/200th part of the incident light and one of 1,000 miles hardly 1/40,000th of it. Now a line between two points 1,000 miles apart on the Earth's surface passes at most about 31 miles below the Earth's surface—less than 1/100th of the Earth's radius.

Hence a ball of air as big as the Earth, when seen from a distance, would be entirely opaque except for a very narrow rim around the edge. A body as big as the stars would be still more so—so that, of whatever materials a star may be composed and however purely gaseous they may be, the star as a whole must be an opaque body.


At 9 o'clock: Feb. 6.
At 8½ o'clock: Feb. 14.
At 8 o'clock: Feb. 21.

At 9½ o'clock: March 1.

At 9 o'clock: Mar. 8.
At 8½ o'clock: Mar. 16
At 8 o'clock: Mar. 23.

NIGHT SKY: FEBRUARY AND MARCH

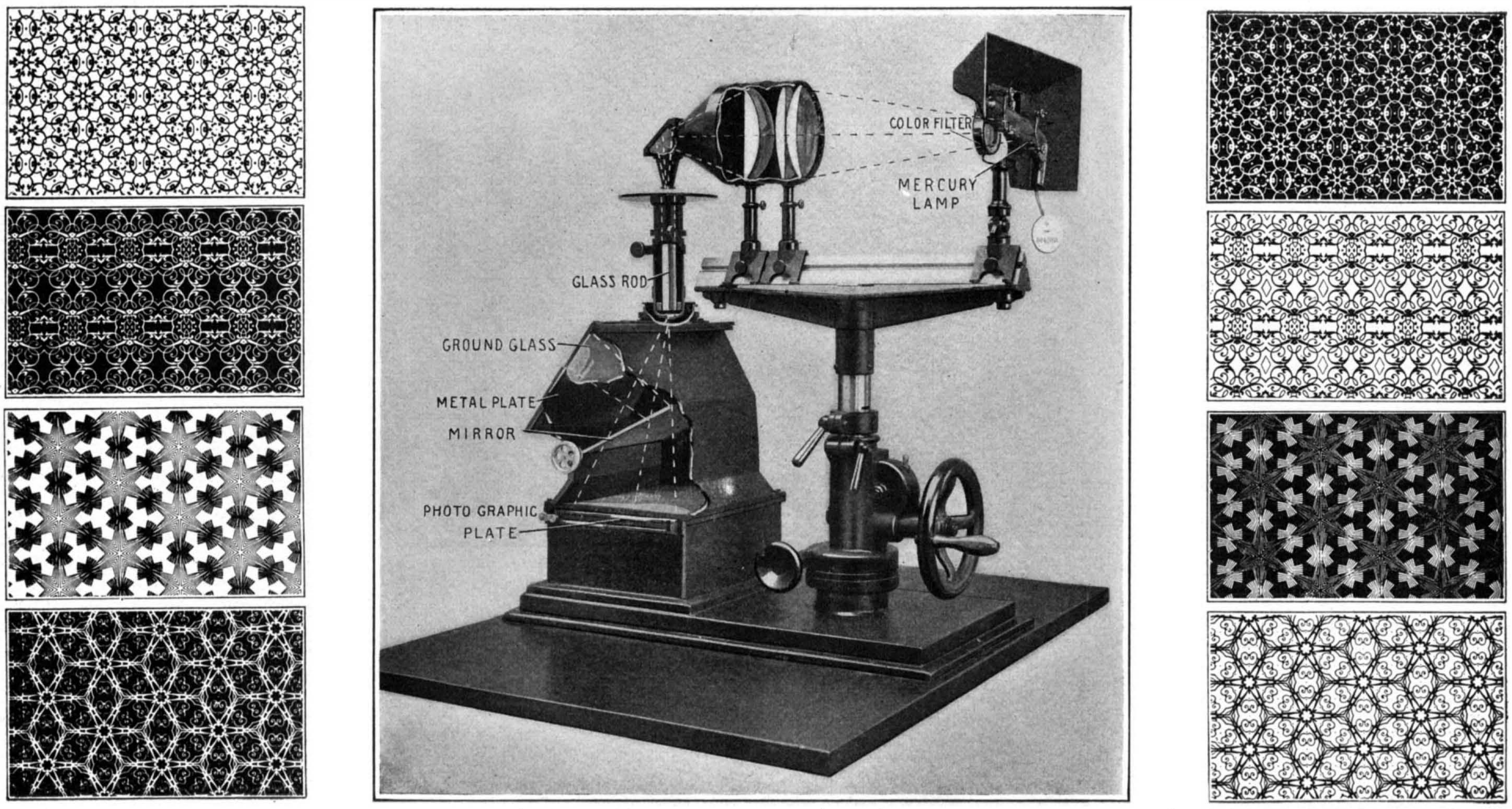
### The Heavens.

Our map shows at a glance what constellations are to be seen in the evening heavens—the splendid group in the southwest—Orion, the Great and Little Dogs, Gemini, Taurus, and Auriga. In the northwest are Perseus, Andromeda, and Cassiopeia; in the northeast, Ursa Major, Boötes, and Draco; in the east, Leo and Virgo; while Cancer and Hydra occupy the dull southeastern sky.

### The Planets.

Mercury is evening star until the 21st, when he passes north of the Sun and becomes a morning star. During the earlier part of the month, and especially about the time of his greatest elongation on the 6th, he is admirably placed for observation, setting about 6:50 P. M., which is an hour and a half later than the Sun. On the 1st he is in conjunction with Jupiter, the two planets being little more than half a degree apart, with Mercury to the northward. Jupiter is about three times the brighter of the two, but Mercury, too, is above the first magnitude, and the two will form a very pretty picture. The two planets slowly separate until

(Concluded on page 108.)




**The photo-kaleidoscope is an instrument which for the first time renders it possible to fix the patterns of a kaleidoscope photographically for the use of textile and wall paper designers.**

# The Photo-Kaleidograph

## A New Instrument That Facilitates the Designing of Artistic Patterns

By the Berlin Correspondent of the Scientific American

IT is not generally known that the kaleidoscope, so far from being a mere children's toy, has been occasionally put to practical uses, and has rendered good services in the designing of artistic patterns for weaving mills, and embroidery, tapestry, and linoleum factories. Attempts have also been made from time to time to combine the kaleidoscope with a photographic camera, though no appreciable success has been obtained in this connection.

Dr. C. Pulfrich of Jena, Germany, the well-known expert in the field of optics, has perfected an apparatus of precision which would seem to be eminently suitable for commercial purposes, yielding as it does a startling variety of striking and artistic patterns for visual inspection as well as photographic recording. This apparatus has been one of the attractions of the International Exposition of Printing, held last summer at Leipzig.

Whereas in Brewster's classical kaleidoscope, images are generated by reflection on plane mirrors, Pulfrich uses the sides of a straight, massive glass rod instead, which are ground and polished with all the accuracy obtainable in large optical works such as those of Zeiss. The angles are likewise adjusted with the utmost precision to the figures prescribed in each case. The glass rod is silvered throughout its length and is protected against damage by strips of black glass glued around its circumference. Its two ends are ground plane and polished at right angles to the length of the rod. The whole is surrounded by a metal tube, allowing only the ends to project.

The tube thus arranged is situated vertically above a horizontal photographic plate (13.18 centimeters), the objective being screwed to the lower end of the tube. The distance of the tube from the plate is so adjusted as to project a sharp kaleidoscopic picture on the latter. A set of such rods of various cross-sections is provided, which are readily exchangeable, the external diameters of all the tubes being rigorously the same. Each tube is held in position by a set-ring so adjusted as to insure a maximum definition of pictures.

The fundamental pattern from which the kaleidoscopic picture is to be composed is applied to the upper free end of the glass rod; photographs on glass are used exclusively for this purpose, thus insuring perfect contiguity between the various sections of the picture. A drop of oil having been put on the end of the rod, the glass picture, with its sensitive layer turned toward the glass rod, is slightly pressed against the latter. The rod then chooses from the picture a section of the size and shape of its cross-section, and by reflection, produces the most varied juxtapositions of this section, so as to form an endless variety of patterns.

The pattern is lighted by mercury light traversing an optical filter, thus leaving only the beams corresponding to one of the violet mercury lines for producing the kaleidoscopic pictures. A slanting plane mirror inserted between the object and slide projects the kaleidoscopic pictures on a ground glass screen and allows the patterns to be inspected and selected at will. In fact, they can thus be examined by several persons simultaneously. Whenever a pattern is thought worth recording, the mirror is thrown aside by turning it round a horizontal axis, and is kept in position by a bolt, during the time required for a photographic record (about 1 minute). The photographic view having been taken, the mirror is reduced to its original position, where it forms a light-tight inclosure for the photographic plate, while the picture reappears on the ground glass screen.

The ground side of the screen is turned outside and can be used for tracing the outlines of certain parts of a pattern.

Dr. Pulfrich's new apparatus enables an infinite variety not only of surface patterns, but of rod and band patterns and rosettes to be generated. Any photographic glass picture can be used as a basis, and kaleidoscopic pictures themselves can be employed in turn for the production of new patterns.

Each glass rod and tube can also be used separately for the inspection of kaleidoscopic pictures, the photographic objective being replaced by a lens.

The apparatus obviously admits of a number of uses in the lines of industry above referred to. It may prove desirable to supply it with an attachment for reproducing any individual picture.

### "Mission Memories" Wins the Trade-mark Contest

IT will be remembered that a few weeks ago a notice appeared in the SCIENTIFIC AMERICAN stating that Mr. E. Moulié, of San Diego, had offered a prize for the best name that would serve as a trade-mark for the perfumes manufactured by him, and that the decision was to be made by Munn & Co. The time limit having expired the judges have performed their task, and have decided that the winner of the prize of twenty dollars is Amy Sebree Smyth, of San Diego, who suggested the term "Mission Memories."

The announcement aroused an unexpected amount of interest and a large number of valuable suggestions were received. The judges found their task by no means easy, both on account of the mass of material to be examined, and especially because of the conditions of the contest. In matters of this nature it is not only necessary to select euphonious words, which will be suitable from the user's point of view, but such words must also conform to the requirement of the Trademark Statutes, which among other things prohibit the use of a personal name, not distinctively written, words or devices merely descriptive of the goods with which they are used, or of their character or quality, or merely geographical names. There are also other technical points that must be kept in mind, so that the work of the judges in scrutinizing the very considerable list of words and terms had to be most carefully and skilfully performed. It was found that the statutory requirements were not nearly as well met as the business necessities. After careful consideration of all the conditions, both statutory and business, the term "Mission Memories" was considered to best fulfil all requirements, and the award was consequently made to it.

### Lock for Bicycles

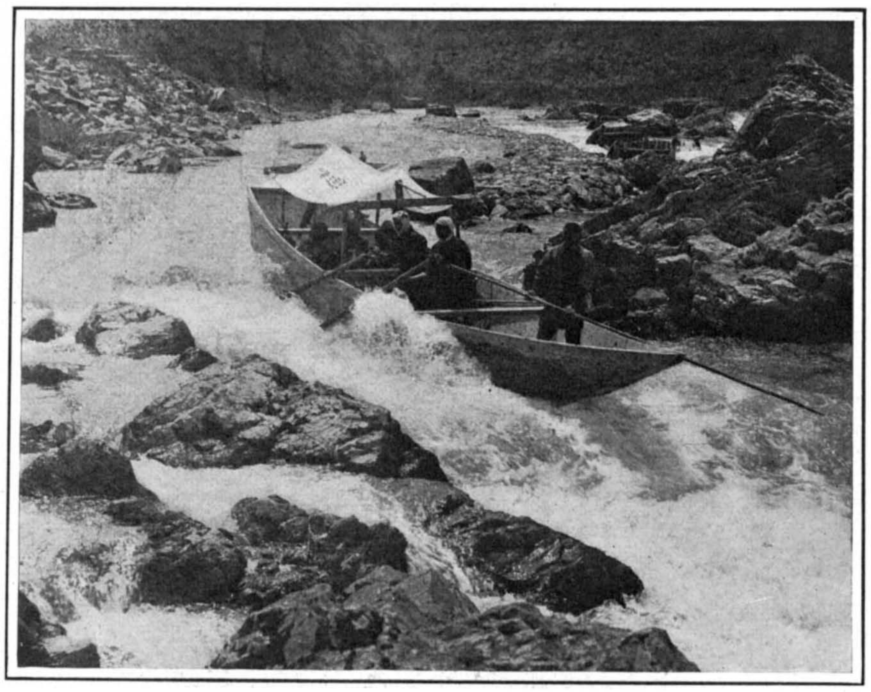
AN excellent method for locking bicycles to prevent them from being stolen is used in France, and it is one of the easiest to fit on by a clever amateur. The device is applied to that part of the frame where the front fork joins the main or upper horizontal tube of the frame. On the head of the fork is placed a stout collar, preferably riveted on to prevent turning, the collar having a projecting wing at the back so that this projects over the horizontal bar. On the bar itself is placed a second collar having a vertical projection which is pivoted to the collar. The combination makes one fixed and one movable wing which can be brought together, and a padlock is passed through holes in each. The trick of the device is that the first wing lies at a slight angle, due to the mounting of the collar, so that when locked, the front wheel no longer lies straight, but somewhat inclined, and in this way it is impossible to ride the machine.

### A New Bead-string Fastener

THE clasps or fastenings ordinarily employed on strings of beads, such as the popular pearl necklaces, are objectionable not only for insecurity in many instances, but also because they make a break in the continuity, and when they slip to the front of the wearer detract from the appearance. It has been suggested that possibly some form of fastener might be devised which would include as its elements bead structures corresponding to the other units of the necklace.

## Shooting the Hozugawa Rapids

FOR the price of eight yen, equivalent to $4 in our money, one may purchase the thrilling experience of shooting the rapids of the Huzu River, or Hozugawa, which flows from the highlands of Japan past the ancient capital, Kyoto. Expensive as this means of transportation is, the farmers of this particular section of the country must pay the price of eight yen per boatload to ship their produce to market. To successfully navigate the craft, such as is shown in the accompanying illustration, requires not only considerable skill, but also daring, as the fast waters of the Hozugawa are extremely treacherous and dangerous, many persons having lost their lives there.



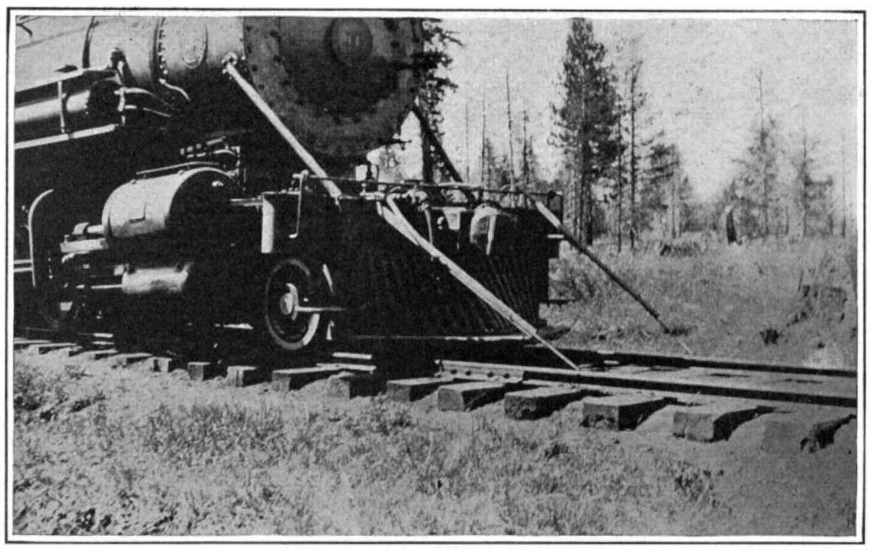
Shooting the Hozugawa Rapids, Japan.

## Fighting Caterpillars With Steam

HORDES of caterpillars proved a serious menace to railroad operation this summer on the McCloud River Railroad, in Northern California. Locomotives could not make traction because of the millions of wriggling crawlers that clogged the rails, forming a slimy mass as the engine passed over them. Sand was of no avail; cresol sprinkled along the rails checked them for only a brief time; and the expedient of placing men on the cowcatcher to sweep off the creatures with a broom was of no value at all. More caterpillars were crushed by the brooms than were brushed clear of the tracks, while those that escaped alive promptly crawled back upon the rails before the train had passed.

Apparently the railroad was under the necessity of digging trenches for many miles along both sides of the right of way, a very heavy outlay, but the only effective method so far discovered of holding the creeping hordes in check. This method had been used with success in the lumber camps of that section, which had also been overwhelmed with the pest.

However this great expense was done away with by an invention of Master Mechanic John Kennedy, who devised a system of forcing live steam from the locomotive boiler upon the rails ahead of the cowcatcher. The heat killed the insects, while the force of the jet threw their bodies off the track without crushing them. In this manner, the problem was solved with slight expense, as Mr. Kennedy's invention was of extreme simplicity. It consists of a couple of small tubes extending from the boiler to the front of the locomotive and terminating a few inches above each rail. The engineer controls the steam outlet with a simple device. After using this invention for a short period, the bodies of countless thousands of caterpillars were banked alongside the track for miles.



Locomotive equipped with steam jets to clear the tracks of caterpillars.

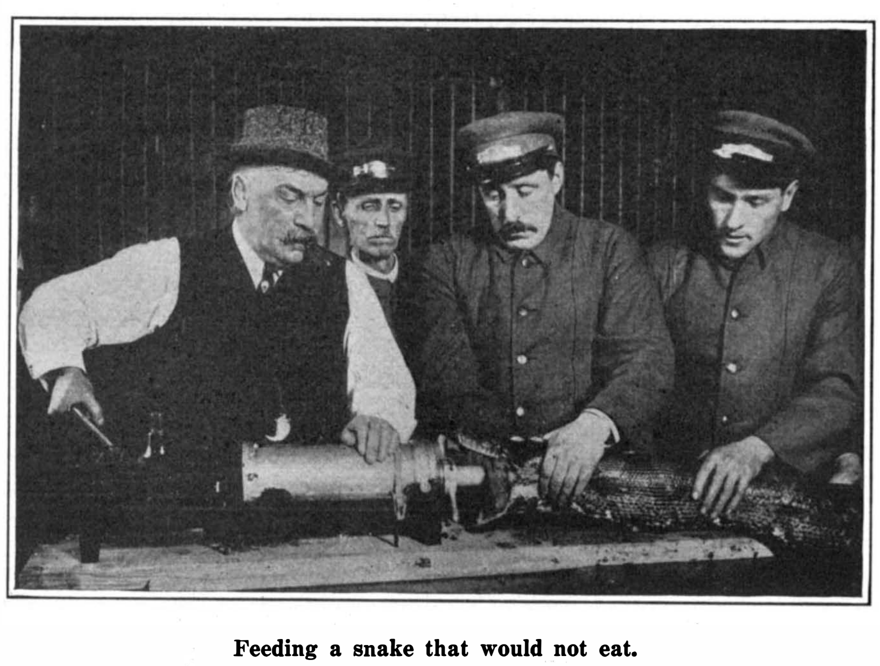
## Forcible Feeding in the Lincoln Park Zoo

LAST spring, "Romeo," a huge snake, was trapped in an Indian jungle and brought to the Lincoln Park Zoo in Chicago. Since then thousands of park-goers who have seen him coiled up in a glass case in the monkey house have thought the snake was dead. But "Romeo" was simply on a hunger strike. Months passed and "Romeo" would not eat. His weight dropped from 300 to 215 pounds. De Vry, the animal keeper, got a mate for the reptile, but "Romeo" remained disconsolate.

One day recently De Vry saw a picture of a "gun" used to feed sick animals, and lost no time in procuring one.

When the gun arrived it was immediately put into service. Twenty keepers led the snake from the glass case and plunged it into a tank of hot water. There his summer coat was removed. The snake was then placed on a fifty-foot board. Forty hands were required to hold him still. The "gun" was fastened at the head of the board. Twenty pounds of chopped pork and beef, mixed with fresh pig's blood, were placed in the cylinder of the feeder, to which a hose was attached. One of the attendants took a pointed stick and forced the snake's mouth open. Whereupon the keeper inserted a board between the jaws. There was a hole in the board to allow the passage of the meat.

The snake was then dragged up to the machine, the hose was placed in his mouth and the crank turned. Fifty pounds of meat was "shot" down the snake's throat before the operation was finished.



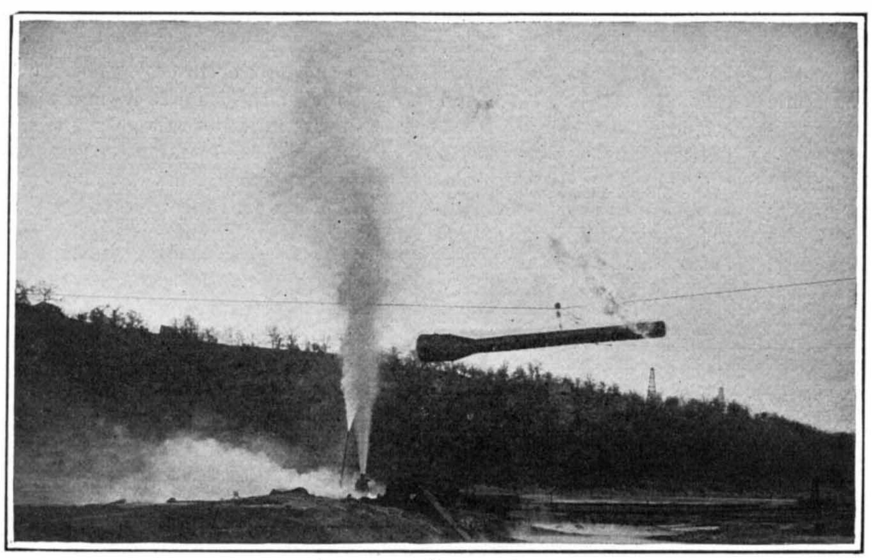
Feeding a snake that would not eat.

## The Current Supplement

MANY references have been made to the method of passing vessels through the locks at the Panama Canal, but there has been no real description of the ingenious electric towing locomotives that have been specially designed and built to do this important work. The article on this subject in the SCIENTIFIC AMERICAN SUPPLEMENT, No. 2039, for January 30th, 1915, gives such a description, with a number of illustrations that fully show the system adopted, and it will be found a matter of general interest. There is also a valuable paper by Prof. Joly, the well-known scientist, on the Birth-time of the World, discussing various methods of estimating the age of the earth; and the interest in this is increased by the paper on Sea Salt and Geological Time, by H. S. Shelton, who criticizes Prof. Joly's theories. Plancton, the Ultimate Food, contains a fund of information about a form of marine life that, although vast in extent, is little known generally. The Function of Enzymes, those products of living cells that so wonderfully affect the chemical operations of living matter, is the subject of an article dealing with some of the mysteries of life. Roentgenology in War tells of the methods of adapting modern science to the necessities of surgical work in the field. The Hygienic Home impresses some facts of everyday life that should be more thoroughly known and appreciated. There is a third article on liquid crystals by Dr. Lehmann, as well as some notes on the Hypnosis of Fear. In technical subjects there are interesting notes on Iron Manufacture by Electrolysis, and the valuable review of Arithmetical Machines is concluded. The description of a new Hydrogen X-ray Tube, possessing special qualities, is of more than passing value.

## Extinguishing a Burning Oil Well

THE accompanying photograph illustrates the plan which was successfully employed in extinguishing a burning gas well in the bed of the Cimarron River, in the Cushing oil field, Oklahoma. The well, before the fire, registered sixty-two million feet of gas. It could not be controlled, and it finally caught fire from a campfire nearly a quarter of a mile away. A wire cable was stretched across the river. On this an immense hood with a tall smoke stack attached, was suspended, and this was finally dropped over the gas. Another cable had been attached to the stack and carried to the river bank. Then a team of horses was hitched to the latter cable. Steam from six boilers was carried to the mouth of the well. All the time the blaze was coming out of the stack. The stack and hood was jerked by the team far away from the well, thus carrying the flame far away from the well, the gas in the stack still burning. Then the steam was turned onto the mouth of the well, diverting the gas still further from the flame, and the fire was thus extinguished.



Extinguishing a burning oil well by diverting the flaming gases.

## Profit From Forests

MANY European towns and cities own considerable areas of forest lands, and as these are in almost every case under the constant care and supervision of qualified foresters they are a source of steady profit to the communities. An example of this is cited in recent forest notes by the U. S. Department of Agriculture, which states that Zürich, Switzerland, derives an annual income of $7.20 per acre from her forests, which results in a reduction in the taxes of $32,000 each year.

## RECENTLY PATENTED INVENTIONS

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

### Pertaining to Apparel.

DRESS FORM.—M. A. KONIKOFF and H. R. KONIKOFF, care of Kayes Mfg. Co., 496 E. 134th St., New York, N. Y. This invention relates to dress forms, including both the bust and skirt portions, and the main object thereof is to make such forms collapsible, whereby less space is required for storage and for shipping with the consequent saving.

CLOTH CUTTER.—L. H. WILLIAMS, 414 E. Augusta St., St. Joseph, Mo. This cutter has a knife normally disposed within a casing which is mounted on a track bar along which it is adapted to move, the track bar having means for holding the cloth to be cut against a corrugated member on a base to which the track bar is articulated.

WEATHERPROOF GARMENT.—S. LIPMAN, care of Eloisser, Hyman & Co., 77 Battery St., San Francisco, Cal. The garment is preferably in the form of a shirt, more especially designed for use by loggers and other persons and arranged to conceal a weatherproof lining or cape and to allow convenient removal thereof to permit of washing the garment when desired to do so.

### Pertaining to Aviation.

AEROPLANE.—O. CALUM, 634 Union St., Brooklyn, N. Y., N. Y. The aeroplane is arranged to provide a large sustaining area in a comparatively small space, to insure easy rising and descending of the aeroplane, to maintain the equilibrium even in heavy sidewise or contrary currents of air, and to allow safe descending in case of accident to the motor or other parts.

### Electrical Devices.

POLE.—A. H. MATTHEW, Colville, Wash. Mr. Matthew's invention relates more particularly to telegraph and telephone poles, and it is a design of the inventor to produce an improved metallic, hollow pole adapted to receive a filling of sand or other sound-deadening material. The pole may be shipped in sections.

OPERATING MEANS FOR ELECTRIC-LAMP SWITCHES.—A. J. TIZLEY, 38 E. 15th St., Brooklyn, N. Y., N. Y. The invention provides a rotary lamp switch member with a stud mounted on a leaf spring and movable in a slot in a casing by a cam mounted on a collar so that the switch member may be rotated a distance by the collar and the cam when the collar is rotated in one direction, the leaf spring permitting the stud to move inwardly out of the way when the collar is rotated in the opposite direction.

MEANS FOR FASTENING THE DANGLING END OF A BROKEN OVERHEAD ELECTRIC CONDUCTOR.—A. JÜRGENS, 133 Springweg, Utrecht, Netherlands. The object here is to provide means for drawing up and fastening the dangling end of a broken overhead electric conductor, to prevent short-circuiting of the electric circuit, and to reduce the danger of electric shocks and electrocution to human beings and animals liable to come in contact with the broken end of the circuit conductor.

### Of Interest to Farmers.

MOWER.—A. H. MATTHEW, Colville, Wash. The invention relates to a mower or reaper, and the aim is to provide a cutting mechanism and actuating means thereof requiring less expenditure of power for effective operation. The invention provides a novel means whereby the cutters may be raised at an angle, for the cutting of hedges.

APPARATUS FOR DRYING MILK.—J. D. MCINTYRE, New York, N. Y., care of W. De Shetley, Illinois Athletic Club, Chicago, Ill. In this case use is made of a driving gear connected with the agitator shaft to rotate the agitator continually at a high rate of speed during the period of changing the milk to a doughy consistency, and to rotate the said agitator shaft at a decreased speed and a corresponding increase of power during a period of changing the milk from a doughy consistency into granular form.

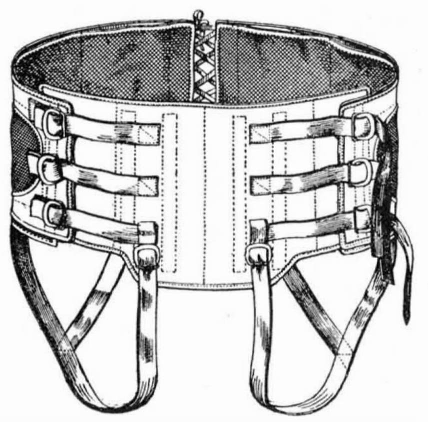
PLOW.—T. N. SEAY, 620 Richland St., Columbia, S. C. This invention pertains to plows and more particularly to an improvement in hand or garden plows. The invention provides a hand plow having a plow share positioned in front of the wheel, so that the wheel travels in the furrow made by the share, thus allowing an easy manipulation of the plow.

COTTON CHOPPER.—E. R. BURKEY and J. F. VOELPEL, Grand Prairie, Tex. In this device a wheel-supported frame is provided, adapted to be drawn through the field with the wheels astride the row of growing plants, and wherein other mechanism is provided in connection with the frame and supported thereby and moving transversely of the row for cutting out the excess plants, the said mechanism being arranged to cut deep or shallow and being controlled by the operator of the machine.

### Of General Interest.

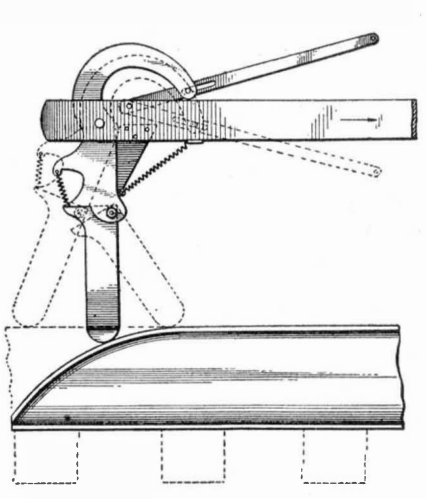
SPOOL.—W. TRENT. Address Frank Strong Stott, Stottville, N. Y. In the present patent the invention has for its purpose the provision of a spool comprising a body and heads detachably connected with the body, and so arranged that when the said heads become mutilated or broken they may be removed from the body and a new head attached.

COMPRESSOR OR ABDOMINAL SUPPORTER.—G. W. KNIGHT, 203 Broadway, New York, N. Y. This invention has for its general objects to improve and simplify the construction of abdominal supports so as to accomplish the purpose for which it is applied and at the same time permit of being easily and quickly attached or detached and while in place be comfortable to the wearer in the natural movements of the body, as in changing from a sitting to a standing posture, or *vice versa*, or in the lateral bending of the body.



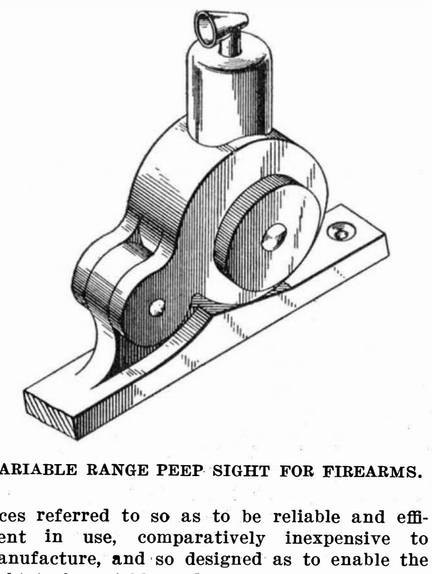
COMPRESSOR OR ABDOMINAL SUPPORT.

AUTOMATIC WHISTLING AND SIGNALING DEVICE.—J. T. DODSON. Address J. E. Rieger, Attorney, Kirksville, Mo. This invention relates to devices for automatically sounding a whistle or other audible signal on a moving engine, car, or motor vehicle at predetermined points along its route of travel. An object is to provide a device of the type described, which is exceedingly simple in construction, consisting in fact of only two main parts on the engine frame, one of said parts being arranged to engage a stationary trip member on the track.



AUTOMATIC WHISTLING AND SIGNALING DEVICE.

VARIABLE RANGE PEEP SIGHT FOR FIREARMS.—J. W. HILL, Palisades, N. Y. This invention relates to sights of the peep type for rifles and other firearms, and has to deal more particularly with adjustable or variable range peep sights. The invention improves and simplifies the construction of devices referred to so as to be reliable and efficient in use, comparatively inexpensive to manufacture, and so designed as to enable the sight to be quickly and accurately adjusted for any range within the capacity of the firearm to which it is applied.



VARIABLE RANGE PEEP SIGHT FOR FIREARMS.

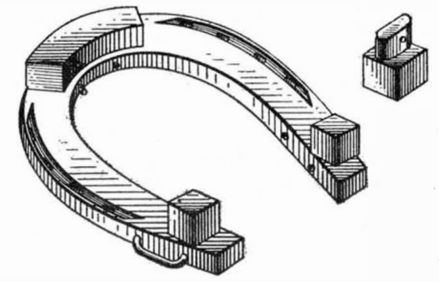
THERMOMETER HOLDER.—C. N. MUELLER and W. V. VAN DOREN. Address the latter, 1646 Garfield Boulevard, Chicago, Ill. This invention relates to a device for holding a thermometer and supporting a receptacle or cup with the thermometer extending thereinto and designed for special use in breweries, distilleries, chemical works and any kind of establishment where liquids are handled under conditions where the temperature must be frequently taken.

OPTICAL PYROMETER.—A. C. BURLEIGH, 611 Blackburn Ave., Sewickley, Pa. This inventor provides an indicator which is heated by the passage of current therethrough, which can be regulated for various temperatures, whereby the color of the heated metal can be effectively demonstrated, the indicator including means for holding a strip of metal which can be heated and reheated at high temperatures without changing its physical properties and without oxidizing.

EYE BATH.—J. E. ROSS, 610 E. Elm St., Springfield, Mo. The invention relates to eye baths consisting of an eye cup combined with means for applying water or other liquid to the eye in the treatment of ocular affections. The device includes means for discharging water under pressure and in the form of sprays against the eye, whereby the hydrotherapeutic action of the water is made use of in the treatment of certain diseases of the eye.

MEASURING DEVICE.—R. C. BRADLEY, 612½ Market St., Shreveport, La. The invention relates to measuring devices and more particularly to a computing cup or scoop. It provides a scoop which may be adjusted for measuring predetermined quantities of commodities and which will indicate the price to be charged for each quantity or amount.

HORSESHOE.—H. PERKINS, Montague, Mass. This invention is an improvement in that class of horse-shoes in which calks are secured to the shoe proper by means of removable fastenings. The shoe is easily manufactured, and combines all the advantages of welded-on calks with the easily removable and replaced calks and locking devices. In recalking shoes, time and fuel of the blacksmith are saved and also the long wait of patrons at the shop while horses are being shod in the old way. On slippery roads dull calks can be readily removed for future use and sharp ones replaced by anyone in a very short time.



HORSESHOE.

### Hardware and Tools.

DOOR LOCK.—M. F. RICHARDSON, 107 E. 128th St., New York, N. Y. This door lock is arranged normally to hold the door securely locked against accidental opening and permitting of unlocking the door from one face thereof by pressure applied to a transverse direction instead of turning a door knob or the like, and to allow unlocking from the other face of the door on pulling the door knob.

WIRE NIPPER AND TWISTER.—J. T. WERTZ, 4312 Vernon Ave., Chicago, Ill. This invention relates to metal working tools and has particular reference to means for gripping and twisting wires such, for instance, as are used for fastening together reinforcement means for concrete structures, although the use of the device is not to be regarded as being limited to the means as herein stated.

CALKING TOOL.—A. E. OLSON, Box 52, Holton, Mich. This tool is for use for filling cracks or seams with cement, pitch, wood filler or similar materials, and is particularly adapted to be moved over a surface after the manner of a plane in which a container chamber is provided, in which a follower is adapted to be depressed to force the filling material downwardly through the bottom of the tool.

DOOR LATCH.—B. L. JOHNSON, Goodhue, Minn. The object here is to provide a latch of a novel form, adapted more particularly to be operated from either side of the barn door, in which the handle part, at the interior of the door, will lie within the plane of the door so as to clear the casing in the sliding of the door.

BARB WIRE REEL SUPPORT.—C. A. BEAUJON, Canaan, Conn. This inventor provides a reel support for use in connection with a spool of barb wire, the reel support including a member extending through the axis of the spool and provided at each end with a sleeve whereby such end may be supported by an operator or otherwise, while the shaft is free to rotate with the spool.

TOOL.—F. S. HARRINGTON, 311 W. 117th St., New York, N. Y. Among the principal objects which the present invention has in view are: to provide a separable head, the parts whereof are readily and economically constructed to strengthen the assembled tool, and to provide for wear on the jointed parts of said tool.

PIPE CUTTER.—W. H. JOHNSON, 6201 Loomis St., Chicago, Ill. This improvement provides a device by means of which a portion of the material of the pipe is removed to form the cut, instead of the material being displaced and wedged apart without removing, as in the case with the commonly used cutter.

PENCIL SHARPENER.—E. A. NUGENT, Unionville, N. Y. This pencil sharpener may be carried on the pencil. It is constructed with a knife which makes, with an oblique cut, a long or short point as desired. This knife may be moved out of operative position when it is desired to move the sharpener up from the pencil point. The sharpener forms a rest for the fingers when the pencil is used for writing.

BRACE.—F. GRUWELL and J. T. MCCANN. Address the latter, Tuolumne, Cal. This invention relates more particularly to a brace level, and one of the principal objects is to provide a brace with a brace level whereby the operator of the brace may instantly ascertain whether the brace is being maintained in a vertical or horizontal position relative to whether a vertical or horizontal position is being bored.

### Heating and Lighting.

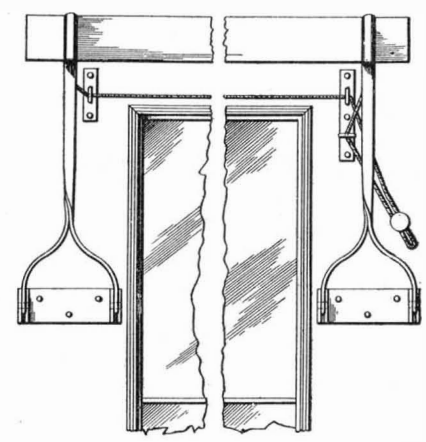
LIQUID FUEL GAS GENERATOR.—R. I. MCKISSACK, P. O. Box No. 1, Nashville, Tenn. This invention provides means for converting liquid fuel into gas combined with adjustable means for mixing the right amount of air with the gas to insure perfect combustion for general and domestic use. It provides a system whereby a more satisfactory initial priming or heating of the generating pipes is obtained for the purpose of starting the process of generating gas from the liquid fuel.

LAMP CHIMNEY.—W. J. WAMBAUGH, Morgantown, W. Va. This improvement provides a chimney adapted to be securely held in position on the chimney support of the lamp by the usual spring clamps to prevent the chimney from toppling over when carrying the lamp about and to insure accurate centering of the chimney relative to the burner.

OPEN FRONT GAS HEATER.—P. MCK. BRADLEY, care of Joplin Stove Co., corner 8th and Main Sts., Joplin, Mo. The invention is an improvement in that class of gas heaters having an open front and provided with curved reflector plates extending backward and upward from the base and forming the back of the cavity or open front of the heater.

### Household Utilities.

ADJUSTABLE CURTAIN POLE BRACKET.—A. C. MCARTHUR, Grafton, New South Wales, Australia. This invention has reference to a hanging device for curtains whereby these articles can be kept clear of the wall and may be readily lowered for changing or other purposes. According hereto poles for carrying curtains are supported in rings or brackets secured to the wall, one on each side of the window. Means are employed for retaining the brackets in any desired position.



ADJUSTABLE CURTAIN POLE BRACKET.

WASHING MACHINE.—A. D. BAIRD and EFFIE J. FAVOR. Address Andrew D. Baird, 23 South St., Medford, Mass. The invention provides a portable clothes carrying drum and means for quickly and easily attaching it to a stationary tub and for rotating the drum when in position. It provides a pair of brackets to be secured to the walls of a stationary tub, to support a rotary clothes carrying drum, the brackets also provided with means for rotating the drum in supported position.

FAUCET.—F. BECKER, National Café, McKeesport, Pa. Among the principal objects which the present invention has in view are: To provide a driving faucet having means for preventing the flow of the liquid while installing the faucet in service relation; and to simplify and economize the faucet construction.

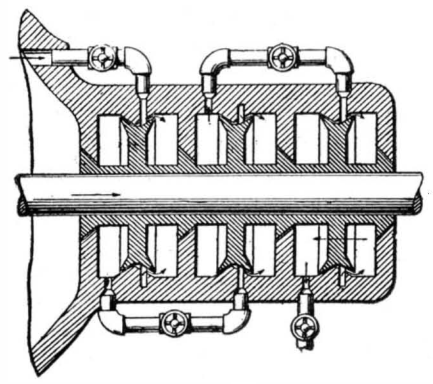
CURTAIN PIN.—E. W. MUNDT, 246th St. and Albany Post Road, Van Cortlandt Park, New York, N. Y. The invention provides a curtain pin of a simple and cheap construction of a nature serving to prevent the fabric from becoming caught or snarled in any manner, and secondly, to provide improved locking means not only for the hook portion, but also for the pin.

CASSEROLE FRAME.—J. J. O'MARA, 261 Lorimer St., Brooklyn, N. Y., N. Y. This invention relates to casserole frames or similar utensils and more particularly to an article employing a method of joining the ends of a band of solid or reticulated material and simultaneously forming a foot and handle and rendering the band continuous in appearance.

### Machines and Mechanical Devices.

STAPLING MACHINE.—A. H. Ferrell, Appleton, Minn. The invention has for its more particular purpose the provision of means for perforating the stock independently of the work done by the staple as the latter is driven into the stock; the perforation being made, however, and the staple being driven into or through the stock at practically a single operation.

COMBINATION THRUST BEARING AND FLUID SEAL.—W. J. Wohlenberg, 542 Boulevard, Norman, Okla. An object of the inventor is to provide a bearing and seal combined in which the thrust is balanced by fluid pressure oppositely directed, with means for automatically adjusting the said oppositely directed

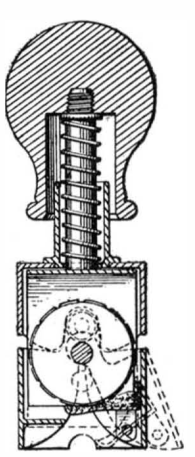


COMBINATION THRUST BEARING AND FLUID SEAL.

fluid pressures. The invention provides a combined thrust bearing and fluid seal wherein the relative position between the rotor and stator is fixed by the fluid pressures oppositely directed. The invention provides a thrust member having a multicellular arrangement in which the fluid pressure is caused to gradually decrease in each successive cell.

SAND PUMP FOR OIL WELLS.—J. H. McGee, Box 342, Humble, Tex. Mr. McGee's invention is an improvement in sand pumps for oil wells and the like, and has for his object to provide a pump especially adapted for removing sand and mud from deep wells, as, for instance, driven wells and the like.

HAND STAMPING MACHINE.—A. Marks, care of The Traut & Hine Mfg. Co., New Britain, Conn. The invention has particular reference to a machine made principally of metal and having consequently a set of metallic type characters as distinguished from stamping de-



HAND STAMPING MACHINE.

vices having rubber characters. An object of the inventor is to provide a device of a very simple and compact nature, whereby the trade may be supplied at a low cost with a machine which will meet all ordinary requirements.

BORING DEVICE.—J. E. Brooks, H. H. Sleppy, and J. J. Yarnell, East Wilmington, Cal. An object of this invention is to provide a power device by means of which post holes or holes for electric light poles may be bored quickly and economically. A further object is to provide means for boring holes of different depth.

NEWSPAPER WRAPPING AND LABELING MACHINE.—E. T. Peterson, Cimarron, Kan. This invention relates to wrapping machines or the like and has particular reference to machines which are adapted to wrap, seal, and label automatically newspapers or similar articles. Another object is to improve the mechanism for controlling the application of labels to the wrapping paper previous to the application thereof to the newspapers.

DEVICE FOR CLOSING SLIDING DOORS.—J. H. Rye and J. E. Flexner. Address the former, Boissevain, Va. The invention has reference to improvements generally in the means for actuating the door and for the spring mechanism and parts immediately associated therewith, for the purpose of enabling the operator to adjust the sensitiveness of these parts.

ATTACHMENT FOR ROTARY WELL BITS.—T. A. Beecher, Cocharane, Alberta, Canada. This invention relates particularly to a safety device designed to recover lost rotary bits, and has for an object to provide a structure which will not only hold the lost or broken off portion so that the same may be withdrawn, but will cause an indication at the surface showing that the bit is broken or lost.

SWITCH STAND.—S. F. Philips. Address Goldstein and Miller, El Paso, Tex. This stand has mechanism for throwing the switch, and in addition signal mechanism, so arranged and connected to the operating mechanism of the switch that when the switch is in closed and locked position the signal will be at safety, and wherein the signal operating mechanism is so connected with the switch operating mechanism that the latter cannot be operated to open the switch until the signal is set at danger, and wherein the signal cannot be moved into the safety position until the switch is returned to closed and locked position.

MECHANICAL LUBRICATOR.—M. Jaeger, 125 North Terrace, Mount Vernon, N. Y. The invention has for its purpose to provide an improved structure which may be continuously operated and caused to feed any desired quantity of oil either continuously or intermittently to an article or piece of machinery being lubricated.

ATTACHMENT FOR TESTING MACHINES.—G. S. Evans, care of Lenoir Car Works, Lenoir City, Tenn. An object here is to provide a device by means of which a testing machine such as that used for transverse tensile and compression testing is made use of in testing hardness. A further object is to provide a device by means of which hardness may be tested according to the so-called Brinell ball impression test.

HOLDER AND DELIVERY DEVICE.—J. E. Kenkel, care of W. J. Beecher, Great Falls, Mont. This invention provides for accommodating a very large number of toothpicks or matches in a comparatively small space; provides for the convenient manipulation of the device by successive users; and provides a discharge or outlet adapted to be conveniently positioned for the delivery of the articles.

MACHINE FOR REWINDING FILMS.—G. B. Van Akin and J. E. Borst. Address Tripp & Burleigh, Hudson, Mich. In this case the improvement relates to motion picture mechanism, the more particular purpose being to provide a convenient means for rewinding the photographic films, so as to leave these films in proper shape and position to be unwound.

HOT PLATE PRESS FOR WOOD VENEERS.—O. P. Bushnell, 78 Bill St., Belleville, N. J. The invention provides a press adapted to uniformly limit the spread of the plates for the escapement of steam; provides means for regulating the number of times when the plates are spread for the escapement of steam; provides means for automatically opening the plates for delivery of the veneer from therebetween; and provides heating plates having protected steam channels formed therein.

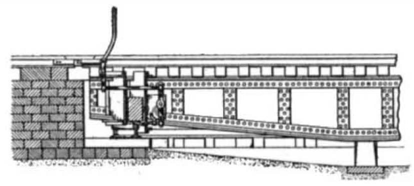
REPEATING RIFLE.—J. W. Montague, 301 Kennedy Block, Portage Ave., Winnipeg, Manitoba, Canada. In this rifle the breech bolt is rotated by the reciprocation of the sleeve and thereby cocks the rifle hammer by a cam action, the cams interlocking after the cocking action has been completed, by a forward motion of the hammer holding the several parts rigid after the bolt is turned, until it is necessary for the bolt to turn back into its proper place.

### Prime Movers and Their Accessories.

WATER GLASS.—L. B. Howell, Wilmington, N. C. This invention has reference to emergency valves as applied to boilers, and an object of the improvement is to provide means for automatically injecting water into the boilers when the water in the boiler has reached a predetermined height.

### Railways and Their Accessories.

RAILWAY TURNTABLE.—A. Meikle, North Transcona, Manitoba, Canada. This invention provides means to chock the turntable at the periphery to prevent a depression thereof by the engine entering the same. A further cause of injury to engines and the turntable is the fact that the track rails of the turntable do not make a close joint with the fixed tracks.



RAILWAY TURNTABLE.

The invention provides means for producing a continuous track from the fixed track to that of the turntable, for which purpose use is made of a filler track section rockably mounted on the turntable, and in order that the filler track section and chocks may move in unison, the said section is mounted on a rock shaft and operative connections established between the said rock shaft and the chocks.

FLAGSTAFF.—F. H. Kinney, P. O. Box 97, Hemlock, N. Y. The invention has special reference to a flagstaff adapted for use on railroads, and provision is made on the base section and in connection with the top member of the cap section for tying the upper and lower ends of a plurality of signal flags, as, for instance, red, yellow, and green flags. Between the top and bottom tying-means for the flags, sliding rings are provided for connection with the respective flags.

CAR DOOR SEALING DEVICE.—H. V. Cookingham and George O. Price. Address the latter, 585 Washington Ave., Albany, N. Y. In this case use is made of a lock-controlling lever fulcrumed on the car door and having an opening for engagement with one of a series of studs held on a keeper fixed to the car door, and a movable locking member on the said lever for locking the latter in position on the keeper when the lock is in open or closed position.

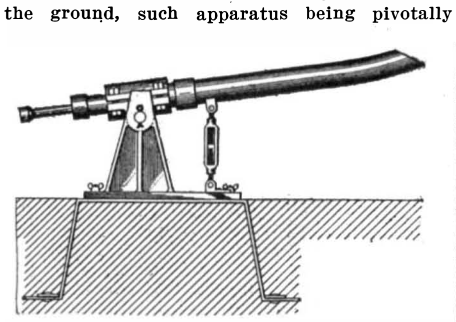
MAIN ROD CONNECTION.—R. M. Musgrove and F. R. Howard, care of Musgrove, Howard & Co., 144 W. First South St., Salt Lake City, Utah. The invention in this instance relates to connecting rods, particularly to those connecting the driving wheels of locomotives, and the main object thereof is to distribute the strain of the engine over all the pins of such wheels equally.

### Pertaining to Recreation.

JUGGLER'S PARAPHERNALIA. — F. P. Littlejohn, care of Vanity Publishing Co., Times Square, New York, N. Y. The object of the invention is to provide a light, convenient and inexpensive device having a brilliant light-reflecting surface not damageable by falling or hammering. This is obtained by providing a device with depressible surfaces on which a light-reflecting medium is provided.

PUZZLE.—B. Gunner, Hillburn, N. Y. This invention relates to the general class of games and toys and has to do more particularly with a pocket puzzle which calls for a display of a high degree of ingenuity and resourcefulness in effecting its solution, while at the same time the puzzle affords considerable amusement and entertainment.

LAWN GAME.—J. Norton, 700 E. 165th St., New York, N. Y. This game, to be known as "Lawnette," consists of a projecting apparatus having means for anchoring the same in the ground, such apparatus being pivotally



LAWN GAME APPARATUS.

mounted so as to be adjusted at different inclinations whereby balls designed for use with the apparatus may be projected at different elevations and distances therefrom.

### Pertaining to Vehicles.

WHEEL RIM.—W. G. Bloecher, 2909 Edmondson Ave., Baltimore, Md. The rim is especially adapted for use with wire wheels and designed for co-operation with interchangeable tire-carrying rims, the interchangeable rims seating outside of the wheel rim, the wheel rim having at one side edge a fixed stop and having at its edge a series of releasable stops to permit the quick removal and replacement of the interchangeable rims.

BALLOON.—L. D. Brooks, 2914 Mission St., San Francisco, Cal. The object here is to provide a device wherein a vehicle is provided having connected therewith a balloon or other envelope for containing gas, having a lifting capacity slightly less than the aggregate weight of the vehicle when loaded, and wherein means is provided for the occupant for lifting the vehicle, and wherein other mechanism is provided for permitting the vehicle to move over the ground.

WHEEL.—C. H. Reynolds, Maxwell, Cal. The purpose here is to provide a wheel adapted for use in automobiles and the like, wherein the hub is resiliently connected with an inner wheel, which in turn is supported by the rim, the hub being so arranged that it may yield in every direction with respect to the rim.

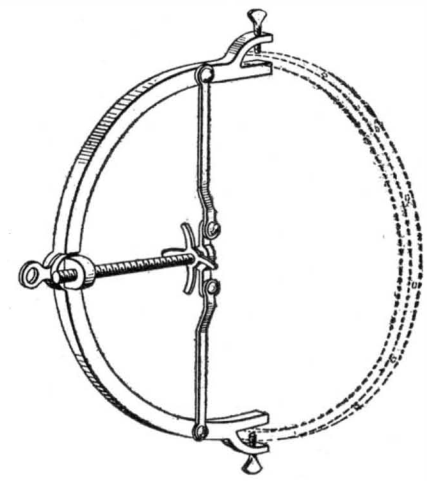
TIRE.—S. A. Sherman and J. Stiveson, 197 Dewey Ave., Youngstown, Ohio. The invention has reference to a tire having a removable wearing tread. The object thereof is to provide a durable tire having a removable tread which can be easily and quickly replaced and which is maintained in proper position on the tire by the resiliency thereof and the pressure applied to the tread.

FOLDING BACK FOR SADDLES.—G. W. Springsteen, 58 Moffatt St., Brooklyn, N. Y., N. Y. This invention provides a folding back for the saddles of motor cycles, bicycles, and other vehicles and devices, and arranged to normally hold the back in an inactive folded position to permit the rider to conveniently mount and dismount, and to automatically move the back into active position relatively to the saddle when the latter is occupied.

DIRECTION INDICATOR FOR AUTOMOBILES.—Victor Gilsey and Olive S. Gilsey. Address the former, 620 W. 122nd St., New York, N. Y. This improvement refers more particularly to a direction indicator for automobiles designed to operate in the rear of a car to warn the chauffeur of an approaching car in the direction of travel of the preceding car, thus providing an efficient means for obviating collisions and accidents which would otherwise be caused.

COMBINED SPEED CONTROLLER AND BRAKE.—T. Douglas, 80 Maiden Lane, New York, N. Y. The invention is especially adapted for use in motor-driven vehicles, and refers more particularly to the combination with a governor for regulating the flow of combustion fluid to an internal combustion motor, of means for admitting non-combustive fluid to the motor, to be compressed and exhausted through the motor, whereby the same serves to operate as a brake.

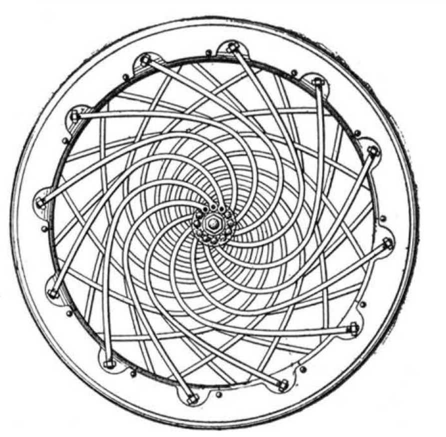
RIM SPREADER.—G. E. Powers, Xenia, Ohio. The invention relates to wheelwrights' tools, and more particularly to a tool for spreading or drawing the rim of a wheel during the operation of attaching the rim to the



RIM SPREADER.

spokes. One of the principal objects is to provide a tool which may be clamped to the ends of a half rim and operated to spread the rim or draw it, as desired, in order to facilitate the adjustment of the rim to the wheel spokes.

RESILIENT WHEEL.—W. H. Randall, 1149 Tauromee Ave., Kansas City, Kan. When this wheel is in use, shocks due to unevenness in the road as the wheel passes thereover will be taken up by the resilient spokes, and when any one section of the rim is bearing against the ground tending to support the weight rest-



RESILIENT WHEEL.

ing on the axle, this weight is carried by the three spokes in turn supported on a single pin. This construction provides that the load on the axle will be successively distributed at diametrically opposite points as the wheel rolls over the ground, and movement or displacement of the rim being taken up by all of the spokes.

### Designs.

DESIGN FOR A COVER DISH.—E. J. Johnson, care of Johnson Bros., 46 W. Broadway, New York, N. Y. In this design for a cover dish the plan view shows a cover oval in form with a handle at each end. This and the side view represent a dish of exquisite lines and effective ornament.

---

## Legal Notes

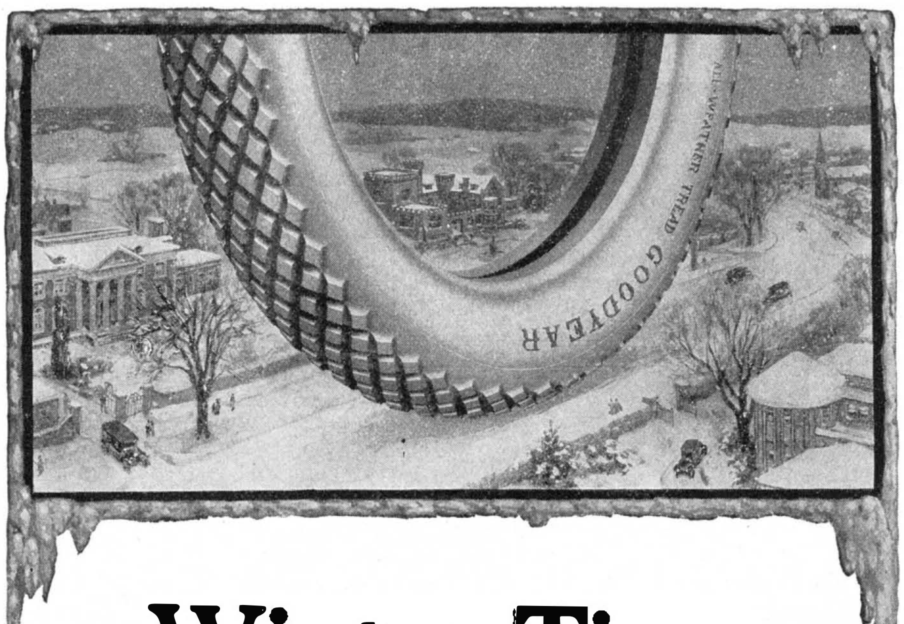
**Design Patents for Parts of Previous Design.**—In *ex parte* Sanford, Assistant Commissioner Newton holds that where a design patent for a pitcher including its top has been granted and later without undue delay the patentee files an application for the top alone, which could not be included in a single patent with the pitcher including the top, the patent does not bar the allowance of the application.

**Reciting Foreign Applications in Oath.**—The importance of reciting the filing of foreign applications, which may have been filed in the oath of the United States application, is emphasized by the decision of Commissioner Ewing in the interference case of Steel and Steel v. Myers. In such case the Commissioner said, "If an applicant who is involved in interference has stated in the oath to his original application that he filed the application in a foreign country, that should be taken, in my opinion, as establishing *prima facie* that the foreign application was filed by him or with his knowledge and consent. If, however, the original oath does not state that the foreign application had been filed, but the allegation is made in a subsequent oath or in the preliminary statement, the applicant should, in view of the conflicting affidavits, be given the benefit of the filing of the foreign application only upon a stipulation of the parties or where it is established by duly taken testimony that he was in fact the party who filed the foreign application or that it was filed with his knowledge and consent."

**Decisions.**—The judgment of the Circuit Court of Appeals for the Eighth Circuit in Rossmann v. Garnier decides some interesting trade-mark questions. It is held that the Federal Courts have jurisdiction of all matters arising under the trade-mark statute, even though both parties be citizens of the same State, and that Congress has power under the Constitution of the United States to enact the trade-mark laws, especially as a "trade-mark" is a distinctive mark of authenticity through which the products of particular manufacturers or the vendible commodities of particular merchants may be distinguished from those of others. It is also held that the provisions of the act of February 20th, 1905, are not limited to technical trade-marks; that a word used exclusively for ten years may be registered under that provision, even though it is a descriptive word, and that where the registrant neither gave notice of the registration by affixing a notice to that effect to the articles sold under such trade-mark nor notified defendant of the infringement, damages were not recoverable for the infringement.

**Some Interesting Ideas Concerning Aggregation.**—Mr. Justice Baker of the United States Circuit Court of Appeals, Seventh Circuit, in Krell Auto Grand Piano Company of America v. Story & Clark Company, et al., suggests that "aggregation" in the law of patents means that the claims in and of themselves, independently of the prior art, show that the elements are incapable of coacting to produce a unitary result. Further that a patent for a mechanism consisting of two or more elements is not necessarily invalid as an aggregation because there is no direct coaction between the elements where such coaction comes to produce a unitary result through the mediation of the operator or the operating force. In discussing the case the Court said, "It is only through the mediation of the operator that the parts coact to produce the new, unitary result. Operator stands as motive power. So the oscillating holder and the fixed cutter can be a lawful combination only because the existence and the proper application of power are necessarily implied."

**Application of Patents as References.**—The case of *ex parte* McCollum decided by Assistant Commissioner Newton is interesting as explaining when a combination of references is applicable. Thus he says, that in determining the patentability of a claim over features found only in a plurality of references, it is necessary to consider the structural differences specified in the claims as well as their functional differences or result and that if the structures






of the several references cannot be combined without the exercise of invention, even though the result is old, the claim should be allowed. Also if the structures of the references may be combined or substituted one for the other and the combined function or result is new, the claim should be allowed. It is only when both the structural features found in the references may be combined without invention to meet the structure called for by the claim and the function or result involves no invention that the claim should be rejected.

### The Heavens in February

(*Concluded from page 102.*)

the 10th, when Mercury will be about 8 degrees above Jupiter; then they draw together again, and are in conjunction once more on the 18th, but by this time they are too near the Sun to be observable.

Venus is a morning star in Sagittarius, and is very conspicuous, in spite of her great southern declination. She is at her greatest elongation west of the Sun on the 6th and rises about 4:15 A. M.

Mars is theoretically a morning star, being just past opposition, but practically he is too near the Sun to be seen.

Jupiter is an evening star until his conjunction with the Sun on the 24th. He will be visible during the first half of the month, as already described.

Saturn is on the borders of Taurus and Gemini and very well placed for observation, crossing the meridian at 8 P. M. in the middle of the month.

Uranus is in conjunction with the Sun on the 1st and is invisible.

Neptune is in Cancer, about one quarter of the way from the fine double star Zeta Cancri toward Beta Geminorum, but is invisible except with telescopic aid.

The Moon is in her last quarter a few minutes after midnight on the morning of the 7th, is new a little before midnight on the evening of the 13th, and is in her first quarter at 10 P. M. on the 21st. She is nearest us on the 7th, and remotest on the 21st. There is no full moon in February this year, though—or, rather, because—there were two in January—on the 1st and 30th. There will be two in March, on the same days of the month.

There will be an annular eclipse of the Sun on February 13th, but it is of little interest to Americans, for the track of the shadow lies mainly in the Indian and Pacific oceans, crossing land only in Western Australia and New Guinea. A large partial eclipse is visible in Australia, and in most parts of the East Indies, but New Zealand lies entirely outside the track even of the penumbra.

Princeton University Observatory.

### Government Co-operation With Our Industries

(*Concluded from page 99.*)

of the German coal-tar chemical industry, for example, cannot now be started in this country. No capitalist would be fool enough to engage in it, without knowing how far he could meet German competition with its own weapons in home and foreign markets. Where, then, is the incentive to spend fortunes in industrial research, in establishing highly ramified channels of distribution, in building up industries which could not long withstand the attacks of a formidable and enterprising foreign competitor who is permitted to use the very implements which our Government has snatched from our hands?

We are not pleading here for a return to the old days when trusts held us in the hollow of their hands, but we are pleading for a judicious and controlled use of the economic advantages that accrue from production and distribution on a large scale. The trust and the cartel are not unmixed blessings for Germany; but so long as they play a predominant part in forcing us out of foreign markets, so long as they are supported by a paternal government as part of a well-planned scheme for German commercial expansion, so long will it be impossible for us to build up great industries dependent on foreign markets as an outlet for surplus products.



## NEW BOOKS, ETC.

THROUGH THE BRAZILIAN WILDERNESS. By Theodore Roosevelt. New York: Charles Scribner's Sons, 1914. 8vo.; 382 pp.; with illustrations from photographs by Kermit Roosevelt and other members of the expedition. Price, $3.50 net.

Theodore Roosevelt is so many-sided that it would be idle to prescribe boundaries to a genius toward which Nature has been so prodigal; but whatever he may or may not be, it is safe to say that he is a born naturalist. His sympathies extend to the most minute life. He is always alert, interested, sensitive to the most subtle impressions, yet almost brutal in his strength to overcome obstacles. Every American must take pride in the zoological and geographical results of the Roosevelt-Rondon expedition. Over 2,500 birds and 500 mammals, besides reptiles, batrachians and fishes, many of them new to science, stand as mute evidence of its zoological success. But its geographic work is supreme. On the map has been placed the River of Doubt—a twice-justified appellation in view of the storm of argument it brewed—now officially known as the Rio Theodoro. This main affluent of the Madeira is 1,500 kilometers in length. As to the literary value of the volume, the author shows himself capable of a simple, plastic expression that passes easily from poetic description to accurate notation and summation; from adventurous narrative to a shrewd appraisal of human traits. His adaptability to circumstance is shown in his keen enjoyment of literary classics while swathed in head-net and gauntlets and weary to the point of exhaustion. The verdict on Theodore Roosevelt's latest work must be that it is a remarkable book by a remarkable American.

THE END OF THE TRAIL. The Far West from New Mexico to British Columbia. By E. Alexander Powell, F.R.G.S. New York: Charles Scribner's Sons, 1914. 8vo.; 462 pp.; with 48 full-page illustrations and a map. Price, $3 net.

The author tells, and tells delightfully, of that West which cannot be seen from a car window or from the terrace of a fashionable hotel. From Mexico to the edge of Alaska he traveled by motor car. Desert dawns, the miracles of irrigation, freakish rocks and rolling rivers—for each natural wonder the author finds the one apt phrase that paints it to admiration. Then there are the man-made curiosities, such as the Acoma dwelling, to the first floor of which you must descend "precisely as you gain access to the hold of a ship." And not least in interest is the man himself in all his varied aspects and activities, but always, schooled by the exactions of his open life, virile and adventurous. Here the old frontier life still lingers, and though the stage that rocks over the mountain road may have motor-power and rubber tires, the old thrills are still there, augmented by several new ones. Ancient, weather-mellowed missions bring into the picture little oases of perfect peace. Farther along are the oil-fields with their gaunt derricks and their oily, pungent streams. Mr. Powell's intense narrative is a book for a man to read.

THE BASKETRY BOOK. Twelve Lessons in Reed Weaving. By Mary Miles Blanchard. New York: Charles Scribner's Sons, 1914. 8vo.; 111 pp.; illustrated. Price, $2 net.

A good manual of a very popular handicraft comes to us under the title "The Basketry Book," in which Mary Miles Blanchard presents a series of graded studies in the art. Basketry, whose origin is lost in the dim distance of antiquity, is the mother of textile weaving. Here its materials, tools and processes, with the eight fundamental weaves, are clearly set forth, and designs both in black and white and in color enhance the beauty and usefulness of the manual. There are work baskets; baskets for jardinieres, flowers and candy; scrap and gathering baskets. The tables of weaves, coils, measurements and borders will prove enlightening to the novice, and the feature of questions and answers is a distinct aid in fixing principles and terms in the memory.

TEN THOUSAND MILES WITH A DOG SLED. A Narrative of Winter Travel in Interior Alaska. By Hudson Stuck, D.D., F.R.G.S., Archdeacon of the Yukon. New York: Charles Scribner's Sons, 1914. 8vo.; 420 pp.; illustrated. Price, $3.50 net.

These arduous journeys over the frost-bound trails of Alaska were undertaken in the routine of religious duties. But the author is not only a Doctor of Divinity. He is also a Fellow of the Royal Geographical Society, and his trained observational powers find swinging scope in the fascinating and informing record of these winter expeditions. The reading public are accustomed to being regaled at one time upon the picture of Alaska as an Arctic waste, at another as an El Dorado. Dr. Stuck errs neither on the one side nor on the other. We see the country in its wilder aspects; we glimpse its possibilities in minerals and in produce. Above all, its enduring and adventurous population appeals strongly to our bias toward the heroic, and instills a vital element into the relation. Such a land must have its problems, and these are sketched with a sure pen. Among the abundant full-page plates which spread the land and its mixed peoples before our gaze are several in color, one, depicting "Overflow Ice," being particularly good. The author has covered his huge canvas in a masterly manner, until the physical characteristics of nature and of man stand out before us in sweeping line, yet rich in varied detail. We hear the eternal phonograph drawl its nasal jokes to the edification of the native Alaskans; we travel glare ice in a temperature of "50 below;" we have an opportunity of contrasting the Englishman and the Eskimo; and we meet the irrepressible pros-


Seen from the rear, William was unrecognizable—but interesting. He appeared to be a walking clothes-boiler, armed with a shield and connected, by means of a wash-tub, with a negro of informal ideas concerning dress. In fact, the group was whimsical, and three young people, who turned in behind it out of a cross-street, indulged immediately in fits of inadequately suppressed laughter, though neither Miss May Parcher nor Mr. Johnnie Watson even remotely suspected that the legs beneath the clothes-boiler belonged to an acquaintance. And as for the third of this little party, Miss Parcher's visitor, those peregrinating legs suggested nothing familiar to her.

"Oh, see the fun-ee laundrymans !" she cried, addressing a cottony doglet's head that bobbed gently up and down over her supporting arm. "Sweetest Flopit must see, too! Flopit, look at the fun-ee laundrymans !"

"Sh!" murmured Miss Parcher, choking. "He might hear you!"

He might, indeed, since they were not five yards behind him and the dulcet voice was clear and free! Within the shadowy interior of the clothes-boiler were features stricken with sudden, utter horror. "*Flopit.*"

The attention of Genesis was attracted by a convulsive tugging of the tub which he supported in common with William; it seemed passionately to urge greater speed. A hissing issued from the boiler, and Genesis caught the words, huskily whispered:

"Walk faster! You *got* to walk faster!"

For further horrible details see "Seventeen," by Booth Tarkington, in the February **METROPOLITAN**—the first of a series of new boy stories by the creator of Penrod. All good newsstands—15 cents.



pector, that burrowing biped to whom hardship and peril are the very breath of life. **All in all, we have seen no more sincere or attractive volume on Alaska than Dr. Stuck's broad and genial, yet shrewd and penetrating, work.**

## Notes and Queries.

Kindly keep your queries on separate sheets of paper when corresponding about such matters as patents, subscriptions, books, etc. This will greatly facilitate answering your questions, as in many cases they have to be referred to experts. The full name and address should be given on every sheet. No attention will be paid to unsigned queries. Full hints to correspondents are printed from time to time and will be mailed on request.

(13033) R. S. J. asks: 1. What is the greatest altitude yet reached by sounding balloons? A. The highest point reached by a sounding balloon of which we have a record is given in the Scientific American, vol. 108, No. 6, page 134, as 23.4 miles. We will send the paper for ten cents. 2. What are the possibilities of the future in ascertaining temperature, wind velocity, etc., at a height of say 50 miles above the surface of the earth? A. Our own opinion is that the air is too rare to support a balloon at the height of 50 miles, and that that altitude will not be reached. Still it is dangerous to say "impossible" in regard to anything. 3. What is the greatest speed in revolutions per minute which has been obtained in practice for a gyroscope? A. We cannot say what is the highest velocity which has been attained by a gyroscope disk. 4. If it were desired to obtain a speed of say 1,000,000 revolutions per minute for a gyroscope or flywheel (supposing heating due to friction overcome) what means could be employed to obtain this speed? A. We do not think the speed of a million turns per minute can be obtained by any means at the command of man. No driving gear could endure such a speed. 5. Is it supposed that the oscillations of a wireless discharge penetrate entirely our atmospheric envelope and continue through space until dissipated? A. The waves of the ether which are used in wireless telegraphy are guided by the surface of the earth, where that surface is a good conductor, and are held to it. They therefore follow the curvature of the earth's surface. You will find this matter discussed in Pierce's "Principles of Wireless Telegraphy," Chapter XV. We will send this book for $3. 6. In theory the ether offers no mechanical friction. What about electro-magnetic waves passing through space? Are they subject to any retardation as compared to their condition in our atmosphere? A. Electro-magnetic waves are sent through space from the sun to the earth. The earth responds to the outbursts upon the sun. And there are those who advocate the theory that electrons are shot from the sun to the earth, giving to the earth its electric charge.

(13034) J. S. H. asks: Do you know of any tool or process whereby I can make a hole in porcelain fuse blocks? Not a matter of cost, but how can I make the holes? A. You can bore a hole in porcelain in the same way that glass is drilled. Use camphor dissolved in a mixture of turpentine and ether. Take 3 parts of ether, 12 parts of turpentine, and 8 parts of camphor. The sharp corner of a freshly broken three-cornered file will serve best as a drill, working it about with the hand. Labor and time will be the principal items of cost, but they "come high." You will find several methods for doing such work in our "Cyclopedia of Formulas," page 491. We will send this valuable work for $5 by mail, charges paid.

(13035) W. L. asks: Please tell me what the heaviest known metal is. A. There are five metals which weigh more than 1,000 pounds per cubic foot. They are: Iridium, 1359-1399; osmium, 1335-1398; platinum, 1322-1354; gold, cast, 1202-1207; uranium, 1143-1163. 2. What is the pressure of water in the ocean per foot in depth, and the weight of water per square inch as the depth increases? I have failed to find this information in your reference books. Have you a small book that gives information along this line on water pressure, and atmosphere pressure, for sale? A. The pressure of water increases below the surface at the rate of 14.7 pounds per square inch for each 34 feet. From this you can calculate the pressure at any depth. The weight of water increases below the surface very little, because water is almost incompressible. Its rate of compressibility is 0.000044, so that at the bottom of the ocean it is only 1/20 heavier per cubic foot than at the surface. This is so little that for moderate depths it may be neglected. We have no book especially upon this subject. These figures are usually given in text books of physics.

(13036) H. A. H. asks: Some time ago, in your query column, you mentioned the name of a text book you could recommend. Would you kindly advise me as to the name of it? Also of any that have appeared in the interim. A. The query to which you refer related to a text book in physics, especially prepared for the use of girls and having especial reference to the household. The text book which we mentioned was Millikan and Gale's "First Course in Physics," which we will send for $1.45 postpaid. Since that query was written two books have been published in this line, Lynde's "Physics of the Household," price $1.45 postpaid, and Butler's "Household Physics," price $1.50 postpaid. **We shall be pleased to fill your order for these books.**

# *What the Small Manufacturer Needs*

THE largest companies have organized Patent Departments, which are as important—if not more so—than the manufacturing force. Their salaried patent experts analyze new ideas produced by research engineers and chemists, secure the fullest measure of protection, and determine whether the idea is worth protecting. They save the waste of re-inventing what is old; they study new and patentable ideas and work hand in hand with the Research Department.

A thousand questions must the experts answer: Is an invention anticipated by prior patents? Can changes be made in the invention which would avoid infringements? If so, what changes? Is the prior anticipating patent or patents valid or not? Who owns the patent which protects a rival product, which seems to be capable of development?

Such questions arise, not only in the business of the large corporations, but of the small manufacturer as well. Because he cannot afford to maintain an expensive staff of patent experts with their assistants, stenographers and draftsmen, he has sometimes seen his business slipping away from him into the hands of a wealthier rival.

The firm of Munn & Co. have instituted a patent service for the small manufacturer, which is designed to give him all the facilities which are now enjoyed by the large manufacturing corporation. Patent experts, many of whom were formerly connected with the United States Patent Office and are specialists in their various lines, will study your products. They will ascertain whether or not adequate patent protection has been, or can be obtained; they will compare from the patent standpoint all the products of the same class now on the market, and determine if it is not possible to effect a profitable combination; they will critically compare your product with that of your rival. In a word, they will see to it that your ingenuity—the most vital asset of your business—is adequately protected.

FOR FURTHER INFORMATION, ADDRESS

**MUNN & CO.**

SOLICITORS OF PATENTS

*Manufacturers' Service Department*

**361 BROADWAY NEW YORK CITY**


# Ideal POWER LAWN MOWER

**Combination Mower and Roller**
**38-inch cut, $400**

THIS newest machine is larger and more powerful than the 1914 model, and carries many improvements that will interest those who have the care of large lawns—golf courses—parks, etc.

A 5 horse-power motor (S.A.E. rating) with 4 adjustable cutter blades, 38 inches wide, and a roller 15 inches in diameter, it cuts 8 acres per day at a speed of 1 to 4½ miles per hour, at an operating cost of only 30 cents per day. It climbs 35% grades, cuts closely and evenly, is easily guided around walks, trees and shrubbery, and rolls the turf as well as cutting the grass, leaving the lawn in perfect condition. Neither hand-propelled nor horse-drawn mowers can compete with this machine in satisfactory results, economy of operation and all-round efficiency.

The Ideal Junior, a smaller power mower, for $225.

Write for catalog and complete description of various sized power mowers.

**IDEAL POWER LAWN MOWER CO.**

R. E. OLDS, Chairman

411 KALAMAZOO ST. - LANSING, MICHIGAN

SUMMARY OF 70th ANNUAL REPORT

OF THE

# NEW-YORK LIFE INSURANCE COMPANY

346 and 348 BROADWAY, NEW YORK

**DARWIN P. KINGSLEY, President**

## NEW INSURANCE PAID FOR IN 1914

Exclusive of Revivals and Increase in Old Policies

# $223,571,200

| TOTAL ADMITTED ASSETS | TOTAL PAID-FOR INSURANCE IN FORCE |
|---|---|
| **$790,935,395** | **$2,347,098,388**<br>JANUARY 1, 1915 |

## Balance Sheet, January 1, 1915

### ADMITTED ASSETS

| | |
|---|---|
| Real Estate | $9,826,142.06 |
| Loans on Mortgages | 156,674,059.30 |
| Collateral Loans | 150,000.00 |
| Loans on Policies | 153,375,218.04 |
| Bonds and Stock (Market Value Dec. 31, 1914) | 438,322,671.10 |
| Cash | 13,964,565.01 |
| Interest and Rents due and accrued | 9,291,253.31 |
| Premiums due and deferred | 9,331,486.79 |
| **Total** | $790,935,395.61 |

### LIABILITIES

| | |
|---|---|
| Policy Reserve | $651,889,465.00 |
| Other Policy Liabilities | 11,856,997.88 |
| Premiums and Interest prepaid | 4,048,933.57 |
| Commissions, Salaries, Taxes, etc | 1,333,293.05 |
| Dividends payable in 1915 | 17,104,119.86 |
| Reserve for Deferred Dividends | 88,902,104.00 |
| Reserves for other purposes | 15,800,482.25 |
| **Total** | $790,935,395.61 |

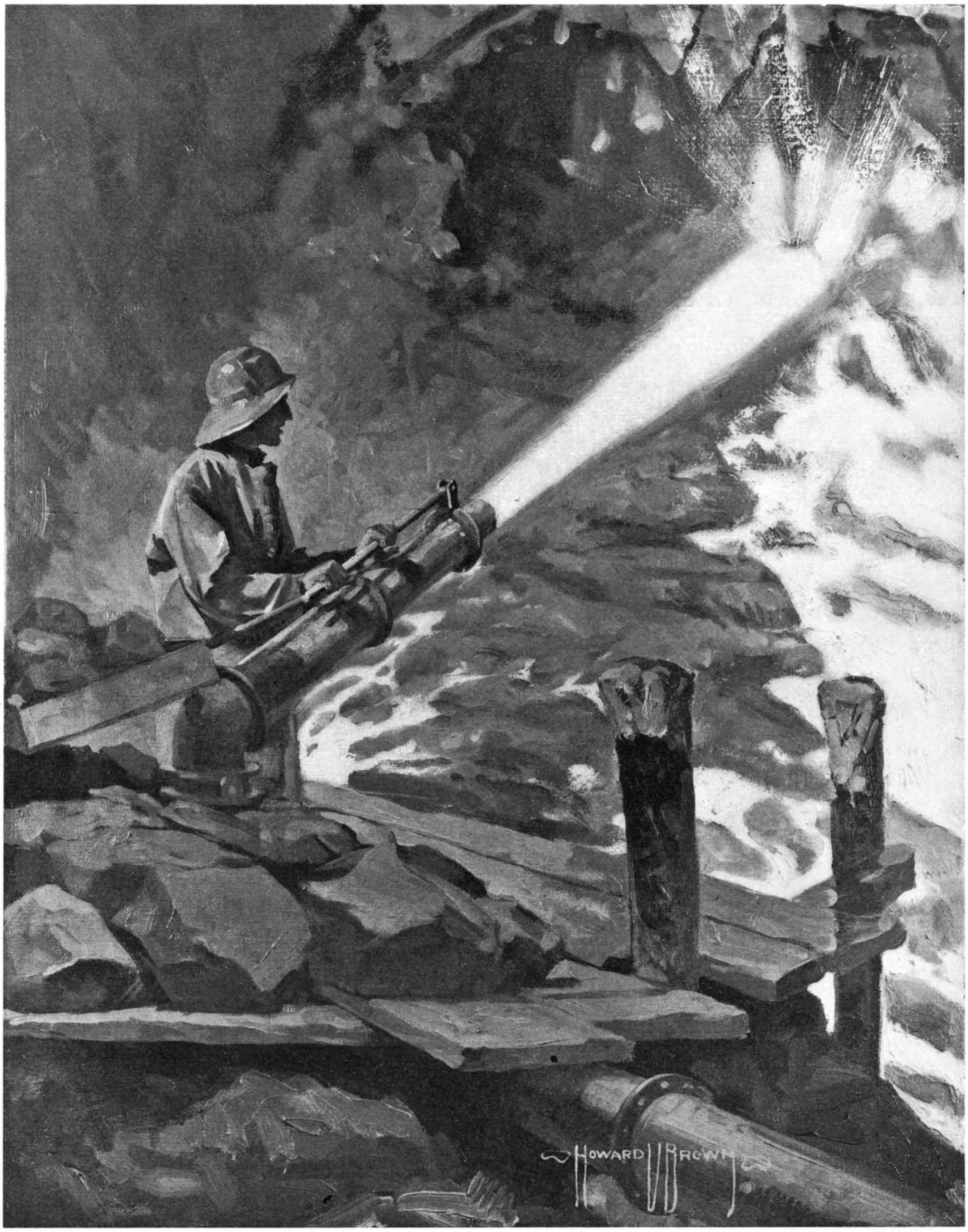
### INCOME, 1914

| | | |
|---|---|---|
| Premiums: | | |
| On New Policies | $9,061,420.82 | |
| On Renewed Policies | 79,153,606.31 | |
| Annuities, etc | 2,252,150.86 | |
| | | $90,467,177.99 |
| Real Estate Rentals | | 693,969.50 |
| Interest on Mortgages | | 7,509,010.87 |
| Interest on Policy Loans | | 7,158,715.58 |
| Interest on Bonds | | 19,293,228.99 |
| Interest on Bank Deposits, etc | | 284,474.61 |
| Profit on Sale or Maturity of Assets | | 30,263.58 |
| Increase by adjustment in Book Value of Ledger Assets | | 256,967.41 |
| Other Income | | 572,766.11 |
| **Total** | | $126,266,574.64 |

### DISBURSEMENTS, 1914

| | | |
|---|---|---|
| Payments to Policy-holders: | | |
| Death Losses | $26,269,756.21 | |
| To Living Policy-holders | 45,693,673.36 | |
| | | $71,963,429.57 |
| Paid under supplementary contracts and other payments | | 365,019.12 |
| Com'ns and other Pay'ts to Agents | | 6,831,867.23 |
| Medical Examination and Agency Expenses, etc | | 2,657,836.44 |
| Home Office Salaries | | 1,786,881.72 |
| Taxes, Licenses and Insurance Dept. Fees | | 1,190,478.01 |
| Rent and Real Estate Taxes and Expenses | | 887,186.65 |
| All other Expenses | | 1,269,732.81 |
| Loss on Sale or Maturity of Assets | | 621,589.06 |
| Decrease by adjustment in Book Values | | 1,704,666.22 |
| For Reserves to meet Policy Obligations | | 36,987,887.81 |
| **Total** | | $126,266,574.64 |

SCIENTIFIC AMERICAN

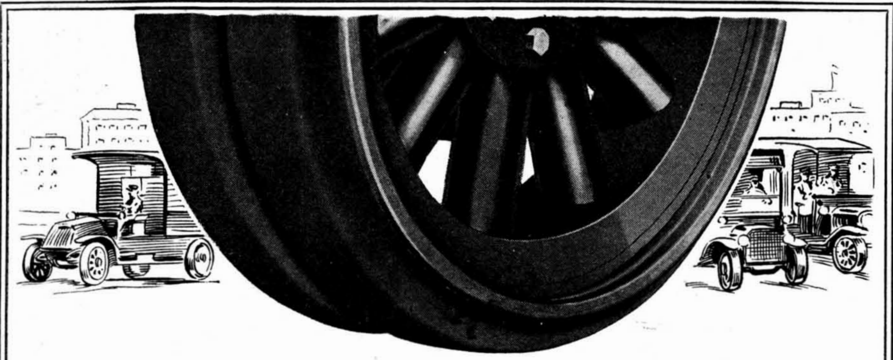



RIPPING AWAY THE OVERBURDEN WITH A GIANT HYDRAULIC JET.—[See page 154.]

Vol. CXII. No. 7
February 13, 1915

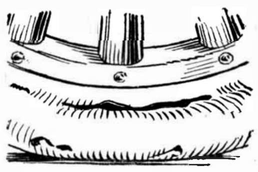
Munn & Co., Inc., Publishers
New York, N. Y.

Price 10 Cents
$3.00 A Year



# What Wrong Tires Do

## These 1915 Goodyear S-V Truck Tires Overcome



Wrong Tires Bulge and Break
S-V's End This Trouble

Learn the results of 2100 actual tests of 1915 Goodyear S-V Truck Tires. See why a growing host of truck owners hails these tires as the conquerors of the road.

Note how they are pressed onto the felloe band—at a minimum of 50,000 pounds. And this pressure far exceeds any strain possible in service.

*Thus the Goodyear S-V Tires end creeping. And they cannot be thrown from the wheel.*

They save the cost of heavy metal bands, bolts, wedges and flanges. They end all preliminary work on wheels.

No other tire goes on like these—in five or ten minutes —*without a single auxiliary fastening.*

Hence they save the expense of carrying excess weight *below the springs,* over thousands of miles.

### No "Lay-Ups" Now

Goodyear S-V Tires end truck tire troubles.

Hence they stop dead losses that accrue when trucks are laid up by wrong tires.

The resilient rubber tread, the hard rubber backing and the steel channel base are welded into one. Our secret process makes this union last throughout the life of the tire.

Wrong Tires Lay Up Trucks
S-V Keeps Them Going

### Give Extra Mileage

Wrong tires bulge—unnatural displacement soon breaks them.

Wrong Tires Creep and Are Thrown
S-V Tires Never

S-V Tires never do that. For the S-V shape—like an ancient pillar—distributes the heaviest load equally.

And they give you 10% more available tread rubber than most other makes.

Hence greater mileage and lower cost per tire mile.

* * * * * *

All makers have striven to solve these baffling problems. Goodyear experts—after 8 years of costly attempts—alone have completely triumphed.

We built, to achieve this, 74 separate truck tire structures in this one type alone. Each overcame some towering obstacle. And the 1915 S-V reaches the summit.

### Write for Cost Records

Let us send you full particulars and definite figures from truck users who compared results.

No need to pay the penalty of wrong truck tires. Let the cost book say which tire you shall specify. Address today—

GOODYEAR
AKRON, OHIO
S-V Truck Tires

**The Goodyear Tire & Rubber Co., Desk 132, Akron, O.**

**Makers of Goodyear Automobile Tires**

**We make Demountable, Block, Cushion and other Types of Truck Tires**

(2199)

# *What the Small Manufacturer Needs*

THE largest companies have organized Patent Departments, which are as important—if not more so —than the manufacturing force. Their salaried patent experts analyze new ideas produced by research engineers and chemists, secure the fullest measure of protection, and determine whether the idea is worth protecting. They save the waste of re-inventing what is old; they study new and patentable ideas and work hand in hand with the Research Department.

A thousand questions must the experts answer: Is an invention anticipated by prior patents? Can changes be made in the invention which would avoid infringements? If so, what changes? Is the prior anticipating patent or patents valid or not? Who owns the patent which protects a rival product, which seems to be capable of development?

Such questions arise, not only in the business of the large corporations, but of the small manufacturer as well. Because he cannot afford to maintain an expensive staff of patent experts with their assistants, stenographers and draftsmen, he has sometimes seen his business slipping away from him into the hands of a wealthier rival.

The firm of Munn & Co. have instituted a patent service for the small manufacturer, which is designed to give him all the facilities which are now enjoyed by the large manufacturing corporation. Patent experts, many of whom were formerly connected with the United States Patent Office and are specialists in their various lines, will study your products. They will ascertain whether or not adequate patent protection has been, or can be obtained; they will compare from the patent standpoint all the products of the same class now on the market, and determine if it is not possible to effect a profitable combination; they will critically compare your product with that of your rival. In a word, they will see to it that your ingenuity—the most vital asset of your business—is adequately protected.

FOR FURTHER INFORMATION, ADDRESS

**MUNN & CO.**

**SOLICITORS OF PATENTS**

***Manufacturers' Service Department***

**361 BROADWAY NEW YORK CITY**

SEVENTY-FIRST YEAR

# SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

VOLUME CXII. NUMBER 7. | NEW YORK, FEBRUARY 13, 1915 | 10 CENTS A COPY $3.00 A YEAR

## Kammerlingh Onnes, the Dutch Specialist in Cold

IN the issues of the SCIENTIFIC AMERICAN and SCIENTIFIC AMERICAN SUPPLEMENT of August 29th, 1914, there were presented accounts of the work at the Cryogenic Laboratory, which is experimenting with very low temperatures, those of liquid hydrogen and helium, of which Heike Kammerlingh Onnes is director. The institution is a division of the Laboratory of Physics of the Royal University of Leyden in Holland. The account in the SUPPLEMENT treats specifically of the work of the laboratory, using material that is still in manuscript or thesis form. It is the intention here to speak of Onnes himself, who is not only the leader in a new department in science, but who has created the department, which includes in its investigations some of the most interesting researches of modern times.

Everyone has heard of liquid air and liquid hydrogen, helium, neon, argon and other gases, and of the solidification of some of them. It is this region of science that Onnes has chosen for his field, and here he has erected for himself and for his university a monument that may well be regarded with pride by his countrymen, celebrated as they are for remarkable investigations. The institution is unique and in a new niche in science, so new that a new word has been coined to describe it, Cryogenic. The root, Κρύος, meaning very cold, is familiar to everyone in the word, crystal, which is a cold form of matter, while students in the high schools will have seen the mineral, Cryolite, which suggests ice and cold in its form, and will perhaps remember the cryophorus, a little instrument of glass with liquid in two bulbs. When one bulb is held in the hand the liquid is driven into the other one by the bodily heat, and as it goes it leaves behind it a very distinct sensation of cold in the palm of the experimenter.

Heike Kammerlingh Onnes was born in Groningen, Holland, September 2nd, 1853, and has spent his life within the limits of that kingdom. He has come to public attention within half a year as the recipient of the Nobel prize for physics. He was a student at Groningen University, receiving the degree Ph.D. in 1879, being at the time assistant in the Polytechnicum at Delft. In 1881, two years following his postgraduate work, Onnes was called to the chair of physics at the University of Leyden, and he is there to-day.

Within two years of his installation as professor of physics, Onnes began his studies of very low temperatures. His reason for selecting this he states himself in the "Abstracts" published by his department. He says: "For ten years I have bestowed all my available time upon an investigation of the manipulation of condensed gases in order to make physical experiments on liquid baths of the very lowest temperatures possible," and in further description he notes that "I was induced to experiment with the condition of gases by the study of van der Waal's law of corresponding states." A little further light is shed on the origin of the researches by the friend and fellow worker of Onnes, Prof. Crommelin, conservator of the Physical Laboratory, who notes that most of the proper ties of substances depend upon thermal molecular activity, and that this becomes weaker at low temperatures. The activity gives rise to some phenomena, and these oftentimes obscure what it is desirable to observe. At low temperatures, therefore, when the activities are slight, there are more favorable opportunities to observe the behavior of the bodies themselves.

In 1894 Onnes describes his infant laboratory, and in excusing its smallness says that only a little of the funds of the Physical Laboratory could be afforded for its maintenance. In later years there has often been mention of its growth, but this in a very modest way, so that public attention has not been drawn to it, and it is most probable that the account of it in the SUPPLEMENT of August 29th is the first of the kind in English.

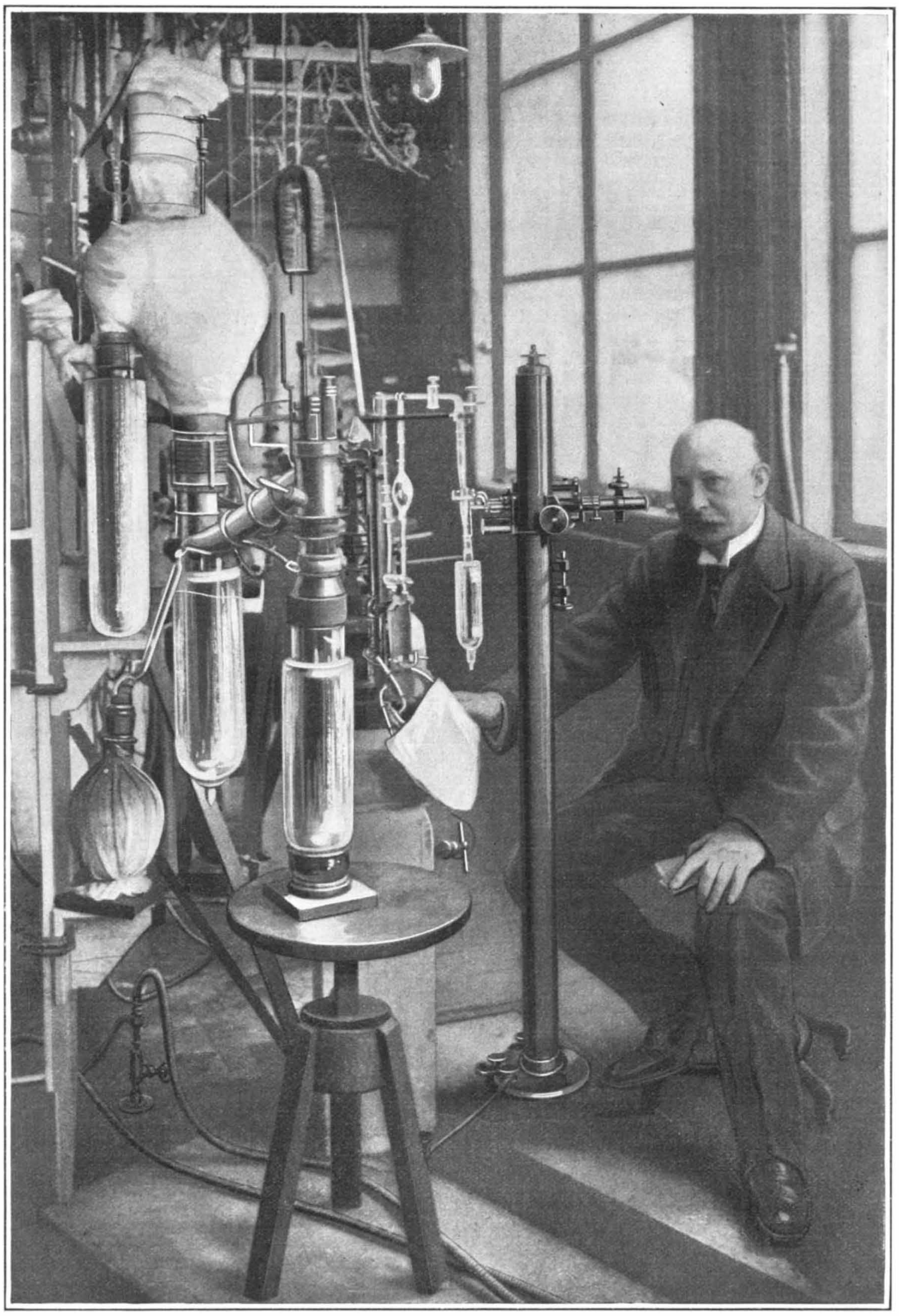
The modesty that has characterized the announcements of the Cryogenic Laboratory is characteristic of the man, Onnes, and this explains why, when the notice was given last winter of the Nobel award to him, there was no one in the popular world who knew about him. The newspapers of two continents had hardly more than a perfunctory notice, while the Who's Who, upon which the press leans very much in personal matters, gave him scant space. The English one had but four lines of biography in 1913, with a single accomplishment credited to him, "The liquefaction of helium." The German one was quite as laconic, while the French, "Qui êtes vous?" makes no mention whatever. By the same token he is not on the roll of complimentary membership of the American Academy, although this society is pretty wideawake in honoring foreign special workers in science.

The larger principles of laboratory policy were presented in the SUPPLEMENT article, and it will here suffice to take up the general lines of investigation which this remarkable man has pursued. As early as 1894, when the laboratory began to publish its "Abstracts," Onnes had printed two papers on methylchloride, which were toward making practical its use as a refrigerant, and in 1896 he presented "Remarks on the Liquefaction of Hydrogen." Then his attention was diverted for a moment to the technique of his work, and he invented a method for illuminating the scales of the instruments that were to be read by reflection, and in 1896 devoted considerable time to the adapting of manometers to the special work of measuring pressure of gases at low temperatures. The field was a new one and the way had to be felt out. It was necessary to invent new methods, to devise new instruments, and these were developed as lower and lower temperatures became more practicable. About this time the need of a name for the kind of investigation was evident, and the word, Cryogen, first appears in print.

For the ensuing ten years gases, conditions of gases, and measurement of gases at low temperatures constituted the principal work of Onnes. Then there came the testing of glass for apparatus, and presently magnetism came into the field. Then work on the thermometry of gases and ever and anon the return to the fundamental proposition, the law of van der Waals.

In 1907 fourteen papers are credited to Onnes, with more than half as many more with collaborators, and this comes to another and a very important matter developed by Onnes, the placing of his personal stamp on all the investigations in the new science. The policy of

(Concluded on page 164.)



Prof. Onnes in his laboratory at Leyden.

# SCIENTIFIC AMERICAN

**Founded 1845**

**NEW YORK, SATURDAY, FEBRUARY 13, 1915**

Published by Munn & Co., Incorporated. Charles Allen Munn, President; Frederick Converse Beach, Secretary
Orson D. Munn, Treasurer
all at 361 Broadway, New York

Entered at the Post Office of New York, N. Y., as Second Class Matter
Entered as Second Class Matter at the Post Office Department, Canada.
Trade Mark Registered in the United States Patent Office



**Subscription Rates**

| | |
|---|---|
| Subscription one year | $3.00 |
| Postage prepaid in United States and possessions. Mexico, Cuba, and Panama | |
| Subscriptions for Foreign Countries, one year, postage prepaid, | 4.50 |
| Subscriptions for Canada, one year, postage prepaid | 3.75 |

**The Scientific American Publications**

| | |
|---|---|
| Scientific American (established 1845) per year. | $3.00 |
| Scientific American Supplement established 1876. " " | 5.00 |
| American Homes and Gardens " " | 3.00 |

The combined subscription rates and rates to foreign countries including Canada, will be furnished upon application.
Remit by postal or express money order, bank draft or check

**Munn & Co., Inc., 361 Broadway, New York**

The Editor is always glad to receive for examination illustrated, articles on subjects of timely interest. If the photographs are *sharp* the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.


*The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.*

## Problem of the Slides at Culebra

If, in the construction of a highway, it became necessary to make a cut through a huge dump which had been formed in depositing the excavated material from some large engineering work, the road-builder would encounter conditions broadly analogous to those which exist on the Panama Canal at Culebra. Let us suppose that the dump consisted of clay, earth, and soft rock interspersed with boulders of large size, and that in opening the cut this miscellaneous material had to be cut through. The contents of the dump, before the cutting commenced, would be in a state of equilibrium and the various materials would overlie one another in strata or masses, at various angles and in a condition of great confusion.

As soon as excavation commenced, the equilibrium of these masses would be disturbed. Where the material encountered was loose in character and possessed but little cohesion, it would tend to slide into the cut until the sides had assumed various angles of repose corresponding to the natural slope of that material. It is conceivable that if the dump had been formed many years before operations commenced, some of the material, such, for instance, as the clay and the mud, having solidified, would stand up, when it was first exposed, at an angle or slope which that material could not maintain after it had been subjected to the influence of the weather. There would be a general disintegration; cracks would open some distance back from the edge of the cutting; and there would be a vertical subsidence and a lateral flow of the material, tending to fill up the cutting. Where huge boulders had been blown into the original dump, or masses of broken rock were encountered, the sides of the cutting would probably stand at the angle determined upon. Broadly speaking, the conditions of the equilibrium assumed by the materials in the dump when it was first made, would be destroyed by the opening of the cut, and it would have to be left to the operations of the laws of gravity, frictional resistance, etc., to determine the time necessary for the walls of the cut to reach a permanent slope.

Now, speaking very broadly, it may be said that conditions at the Culebra cut are analogous to those in our supposed cutting through a dump which had been long enough in existence to have reached a condition of repose. The Isthmus of Panama consists of a mixture of volcanic and marine-deposited material, the latter consisting of the usual silt which in the course of ages accumulates on the bottom of the ocean. Originally, this marine deposit lay in fairly parallel and level strata above the underlying rock. Gradually the whole mass was raised by volcanic action above the level of the surrounding ocean until the Isthmus of Panama was formed. Subsequent volcanic action, resulting in upheaval, caused the igneous rock to be thrust up in places through the overlying marine-deposited material. This upheaval was very irregular, and consequently the overlying mass of softer stuff has been thrown into all manner of confused and more or less broken strata, through which, in such places as Gold Hill, the volcanic rock protrudes.

Now, this confusion would not have been so serious a matter for the construction of the canal, had the whole of the Isthmus been geologically older than it is, and had the softer rock had sufficient time to become thoroughly hardened and solidified. As matters stand, it has been found that wherever the volcanic rock is encountered or wherever the depth of the cut is not too great, the sides of the cut stand at the angle determined upon by the engineers when the plans of excavation were drawn up. But in the deep cutting through the divide at Culebra, the softer material has persistently refused to stand at the arbitrary slope determined upon by the engineers, and has shown a disposition to keep sliding into the canal or breaking away in vertical sections, until a much flatter angle, corresponding to the angle of repose of the particular material at the place of sliding, has been reached.

When water was first turned into the canal it looked as though conditions of equilibrium had been reached, or approached, throughout the whole of the Culebra cut; but subsequently, serious slides have developed on each side of Gold Hill, which forms the ridge of the mountain divide and is the deepest point of excavation throughout the canal. The first great slide was a recrudescence of the activity at the old Cucuracha slide to the south of Gold Hill. The present slide exists in the soft material to the north of Gold Hill. It is a slide of well-recognized character and it presents no novel difficulty—its removal is merely a matter of time and patience.

In a recent interview, Colonel Goethals informed us that the break, about 2,000 feet in length, has occurred about 250 feet back of the edge of the bank at a point where the latter is 250 feet in depth. This mass has settled vertically, and the foot of it has crowded into the canal. At the present time, of this 2,000 feet only 200 feet is giving any trouble. Here the powerful dredges have opened out a channel which is constantly increasing in width and depth. The material of the slide is being taken through the canal to Gatun Lake and there dumped, the work of removal being done at the low cost of 35 cents per cubic yard. According to Colonel Goethals, no new problem is involved in the present trouble, or as he expressed it, the conditions call, more than anything else, for steady dredging and patience.

## Is There Any Defense Against the Submarine?

If we may judge from the number of queries that come to this office, the most interesting technical question of the war, just now, in the minds of the American public, is whether there is any possible means of defense against the submarine. The present article is an attempt to answer this question.

In the first place let it be accepted, once and for all, that if a submarine, and particularly one of the German type, can get within point-blank range of the enemy, the ship attacked will either be sent to the bottom or its days of military usefulness will be over for many a long month to come. One of the most striking evidences of German forethought was their designing of a special type of submarine torpedo, having a limited range of only 1,200 yards, but carrying no less than 420 pounds of high explosive in the warhead. The fact that every warship which has been struck by German submarine torpedoes has gone to the bottom, is conclusive evidence of the terrible efficiency of these weapons.

Protection against the submarine may be sought both in the defensive and offensive direction. One of the principal efforts of naval constructors for many years past has been to afford such effective defensive protection, by means of extensive subdivision below the waterline, that the inflow of water from a torpedo explosion would be limited—so limited, in fact, that the ship would remain afloat and proceed to port under its own steam. The rapid sinking of the "Aboukir," "Cressy," "Hogue" and "Formidable," and later of the "Audacious" (which, even if it was struck by a mine, received a blow but little greater, probably, than that delivered by the German submarine torpedo), has shown beyond all disputation that the submarine, if it once gets within effective range, has the mastery even of the most modern and largest of warships. It is our opinion that, no matter to what extent subdivision may be carried or how great a part of the displacement is sacrificed to torpedo-defense cofferdams or compartments—in view of the increasing size of the submarine, its increasing speed, and the possibility of a yet further increase in the explosive charge of its torpedoes, it will be impossible to render the warship of the future safe or even reasonably protected against submarine attack.

The speed of the submarine is generally so low as compared with that of modern warships, that the chances of its getting within firing range are very much smaller than the average layman would suppose. One of the principal lessons learned in this war is that high speed and quick maneuvering of the ship attacked, combined with a sharp lookout from the masthead, are a most effective protection. In calm weather, when the sea is fairly smooth, the course of the periscope of a submarine is clearly discernible by the long white streak of broken water which it leaves behind. Naval men will tell you that, even when the periscope itself is submerged, there is a certain disturbance of the surface of the water, indicating the presence of a moving submerged body.

When a dreadnought, battleship, or armored cruiser of first-class importance is steaming in submarine-infested waters, it should always be accompanied by destroyers, which have proved, in the operations in the North Sea, that they can "go" for a submarine with all the snap and dash of a terrier after a rat. There have been several cases of successful ramming of submarines by destroyers, and one or two fairly well authenticated cases of the submarine being sunk by gun-fire as it came to the surface for observation.

The difficulty of detecting a submarine increases as the water grows rougher, and it will be remembered that the most successful attacks on large ships have been made in stormy weather, notably in the case of the "Formidable." The wash of the periscope then becomes very difficult to detect.

By far the most hopeful method of protection against this insidious form of attack is to be found, strange to say, in a new form of naval warfare and observation, the dirigible and the aeroplane. Experiments by our aviators during the occupation of Vera Cruz and at other points have shown that it is possible to detect a submarine, when the observer is two or three thousand feet in the air, at depths below the surface of the water which are positively surprising, the submarine being visible in clear and calm water at a depth of fifty to one hundred feet. Now, a submarine which is contemplating an attack has to keep pretty close to the surface so as to "porpoise," as it is called, swiftly and frequently, to take a periscopic peep at the enemy. In rough water vision is not so good, but the submarine can still be seen. Now here is a means of defense, the importance and possibilities of development of which can scarcely be overestimated. A squadron of aeroplanes thrown out in reconnaissance ahead of the fleet would, in any but thick or stormy weather, be an admirable defense against an enemy which "needs only to be seen" to be laughed at.

Regarding the submarine attack on merchant ships in the Irish Sea and elsewhere, it has to be admitted that such vessels are practically defenseless unless they keep a very sharp lookout and are able to show a clean pair of heels to the enemy, which only the faster ships can do. Just now, the development of this form of attack and the question of how it will be met, is one of the most interesting problems of the war.

## The Universal Distrust of the Shipping Bill

Every day brings additional evidence that the sentiment of the country is against the Government Ship Purchase and Ownership Bill. Most significant, because of its widely representative and highly authentic character, was the recent vote against the bill at the gathering in Washington of the Chamber of Commerce of the United States of America, which put itself on record as opposing the measure by a vote of 163 to 90. And this vote, be it remembered, was cast in spite of the fact that Secretary of the Treasury McAdoo delivered at the meeting a most able speech in support of the measure. The New York Chamber of Commerce, equally emphatic in condemnation, has sent out a strong circular against the bill; and, as we go to press, we have received the following letter from Mr. Winthrop L. Marvin, a high authority on the merchant marine, whose articles on this subject in the Scientific American of October 3rd, 10th, and 17th of last year will be fresh in the minds of our readers.

Mr. Marvin writes:

"Your editorial admirably reasons out the case of the people against the ill-advised bill for Government purchase, ownership, and operation of merchant vessels. As I write, a large gathering of representative business men of Boston, of both political parties, in Faneuil Hall, has unanimously adopted resolutions condemning the measure as a long step toward socialism and a peril to our flag. One of the speakers, Mr. Elwyn G. Preston, representing the Chamber of Commerce, said that a Boston company that had just laid down two new ships, of 8,500 tons, would have ordered six ships but for the measure pending in Washington.

"It is manifest to all who live near the sea and have any familiarity with ocean trade that instead of increasing, this ill-starred scheme will reduce the facilities available for the carrying of our commerce. The Administration and Congress lost a great opportunity last August when they failed to take some real emergency step at the very outbreak of the war.

"An offer, then, of a fair compensation adequate to cover the difference between the cost of operation of American and foreign ships would have encouraged the immediate building in American yards of a fleet of cargo steamships, designed for auxiliary naval service as fuel and supply ships in time of war.

"If those ships had been started last August they could have been completed a few months hence. They would have meant a real and valuable addition to our shipping resources for the export of cotton, grain, and provisions. Their nationality would have been unquestioned. We should not be 'buying a quarrel' with these real American ships.

"For this deplorable failure to act with vigor, courage and patriotism, President Wilson and Secretary McAdoo are primarily responsible. No fatuous Government ownership scheme would have been pressed but for their insistence. The American people have a right to ask why this was so. **No answer** has yet been given."

## Notes on the War

**The Future Submarine.**—We do not know of any branch of naval construction more full of promise to the skilled inventor than that of the submarine. There is a call for lighter but more powerful motors, and for greater endurance and speed in the submerged condition. There is a demand for periscopes with a larger and clearer field, that can be operated from greater depths; instruments which will enable observation to be made at depths that would avoid all surface disturbance of the water, save by the periscope itself.

**Impossible to Break Through.**—One of the principal causes of the present deadlock in the western theater of war is the strength of the field artillery coupled with the fact that the terrain back of each line is carefully mapped out for artillery fire, the distance of each square or section from selected battery positions being accurately known. Should a massed attack of the enemy break through in strong force, the troops would find themselves exposed to shell and shrapnel fire of such accuracy and volume that they would be decimated. Without underestimating the value of rifle-fire and the bayonet, it may be said, with fair approach to the truth, that the field gun and the howitzer completely dominate the situation.

**German Warships Still at Large.**—In spite of the sweeping operations of the combined British, French and Japanese navies, four of the armed ships of the Germans are still at large. The fast cruiser "Dresden," which escaped from the battle off the Falkland Islands, is supposed to be somewhere in the Pacific, where also the auxiliary cruiser "Prince Eitel Freidrich" was last reported. In the Atlantic (presumably in the West Indies or somewhere on the northeast coast of South America) are the fast cruisers "Karlsruhe" and the auxiliary cruiser "Kronprinz Wilhelm." Since most of these vessels have recently made no captures, or none that have been reported, it is presumed that they are in hiding in sheltered bays or possibly, like the "Koenigsberg," in some river difficult of access or observation.

**Aircraft on the Battle Line.**—From the "recent notes by an eyewitness" with the British General Headquarters in France, which, by the way, are admirable instances of lucid writing, we quote the following: "There are, generally speaking, two kinds of reconnaissance, whether executed by aviators or cavalry—tactical and strategical. It is difficult to draw a hard and fast line between them, or to define exactly where one begins and the other ends; but the former may be said to be undertaken exclusively for the purpose of ascertaining the strength and disposition of the enemy in a strictly limited area along the battle front, by locating and examining his trenches, gun emplacements, headquarters, reserves, supply parks, and rail-heads. Its sphere ceases at a comparatively short distance in the front of the opposing forces. All that is going on in the area far behind the enemy's line comes within the sphere of strategical reconnaissance."

**Attack of Coast Fortifications from the Land.**—All the guns, big and little, in the coast defenses of the United States point seaward. The parapets, redoubts, etc., which protect the guns are on the seaward side of them. From the rear, these fortifications are completely open to attack; for not a gun points in that direction and the fortifications offer practically no defense from attack by land. We have not enough coast-defense troops to man the batteries; still less have we troops to repel attacks from the land side. If the forts were so taken, the mine-sweeping vessels, being safe from the attack of the rapid-fire guns on the forts, would pass at their leisure through the entrance channels and remove all obstructions. Then our greatest cities could be approached with impunity by the heaviest foreign battleships, which would be free to take up such positions as would best enable them to cover these cities with their guns, and enforce indemnities from the payment of which there would be no escape.

**The German Naval 15-inch Gun.**—According to an artillery expert writing in a German artillery magazine, the latest naval gun, if the ballistic data which he gives are correct, is a truly astonishing weapon. The gun, presumably of 15-inch caliber, is reputed to fire a shell of over 2,000 pounds weight with a velocity of over 3,000 feet a second. If the Krupps have produced such a piece, they must have developed a gun-steel and a powder altogether superior to that of any other nation, our own included. Velocities of 3,000 feet per second for large guns were tried and abandoned several years ago, because of the severe erosion due to the high powder pressure and accompanying heat. To avoid erosion and prolong the life of the gun, the tendency is to increase the weight of the shell and decrease the velocity, our own 14-inch naval guns having only 2,600 foot-seconds velocity, and our 14-inch army guns only 2,250 foot-seconds. We know that one of the leading naval powers of the world recently offered the Krupp agents a very large and remunerative order for guns of the 15-inch, high-velocity type, if the company would guarantee a certain accuracy life; but the guarantee was refused.

## Science

**Health Officers for the Country.**—A recent article in the Public Health Reports suggests a solution of the problem of securing for the rural community a sanitary service analogous to that enjoyed by cities. The solution is exemplified in the experience of six small neighboring town communities which united in the maintenance of a joint health office, with very satisfactory results. While country life is popularly supposed to be more healthful than city life, the reverse is apt to be the case, owing to the fact that public health is more carefully supervised in cities than in country towns.

**"Health News"** is the title of a new series of pamphlets which the U. S. Public Health Service is issuing, chiefly as "copy" for newspapers; the object being to secure wide publicity for important matters relating to public health. These pamphlets are prepared by a manifolding process, and have thus far related to such diverse topics as hygiene in rural schools, the Friedmann tuberculosis treatment, prevention of pellagra, poisons and habit-forming drugs, value of mental hygiene in the development of backward children, and a comparison between modern and 16th century methods of treating vessels infected with plague.

**The Gyro-compass in the Navy.**—Gyro-compasses have now been installed on 20 battleships, 1 armored cruiser, and 15 submarines of the United States Navy, and it has recently been decided to install master compasses in duplicate on all battleships of the "Delaware" class and later. Special attention is being paid to the instructions of officers and men in the care and use of these compasses, by sending them for a month's instruction at the New York navy yard, or at the works where the compasses are made. The Bureau of Navigation also maintains with the Atlantic fleet two chief gunners who have been specially trained as gyro-compass experts, their duty being to inspect and adjust the compasses and give instructions in their use.

**The Etiology of Pellagra** continues to be one of the most actively discussed questions in medical science. Messrs. Siler, Garrison, and MacNeal have recently published the results of a statistical study of the foods used and the occurrence of pellagra in mill villages including about 5,000 persons. These investigations do not show any consistent relationship between any particular food and the occurrence of the disease. On the other hand, they do show that new cases of pellagra have developed almost exclusively in persons living in the houses where cases had previously occurred, or in houses next door to them, from which it is assumed that pellagra is an infectious disease, though apparently it is not readily transmitted to any considerable distance. Elaborate investigations of pellagra are being carried on in several southern States by the Public Health Service.

**A New Race of Pygmies.**—The discovery has just been made in the central portion of the French Congo of a race of pygmies hitherto totally unknown. The members of the race are said never to surpass 1.5 meters, about 4 feet 9 inches, in height. According to *La Revue*, they live entirely isolated in the territory of Mongimbo. They build huts of hemispherical shape in the forest in groups of from 5 to 30. The chief is an old man who exercises absolute and hereditary authority and elects his own successor. They follow a curious custom as to food, the women subsisting on edible roots, while the men live on the products of the chase. According to a legend among them, the former are descended from a hedgehog and the latter from a toad. They have vague notions of good and evil and have a certain cult of the dead, whom they inter with much piety. They are valiant in the defense of their liberty and independence.

**Nocturnal Radiation from the Earth.**—While much attention has been paid in recent years to measurements of the amount of solar radiation received by the earth, at different places and seasons, and under various conditions, there have been comparatively few measurements of another important factor in the thermal economy of the earth; viz., the amount of heat radiated outward by the earth's surface at night. Nominal measurements of terrestrial radiation have generally been limited to the comparison of readings of unscreened minimum thermometers laid on the ground with those of similar thermometers exposed in a screen some feet above the ground. Such observations merely show whether nocturnal radiation has or has not been active, but give no real quantitative values. Since May 14th, 1914, measurements of the loss of heat from a blackened surface freely exposed to the sky at night have been made by the Weather Bureau at Mt. Weather, Va. The maximum rate observed was 0.22 calorie per minute, or 13.2 calories per hour, and occurred on a clear night in early June. The rate has been found to be very uniform during a clear night. If the same rate is maintained during the day, the total radiation from the earth during 24 hours of clear weather in June may amount to 317 calories, or about 40 per cent of the insolation. The average nocturnal radiation in June was, however, less than 60 per cent of this maximum, and continued to fall off as the water-vapor content of the atmosphere increased.

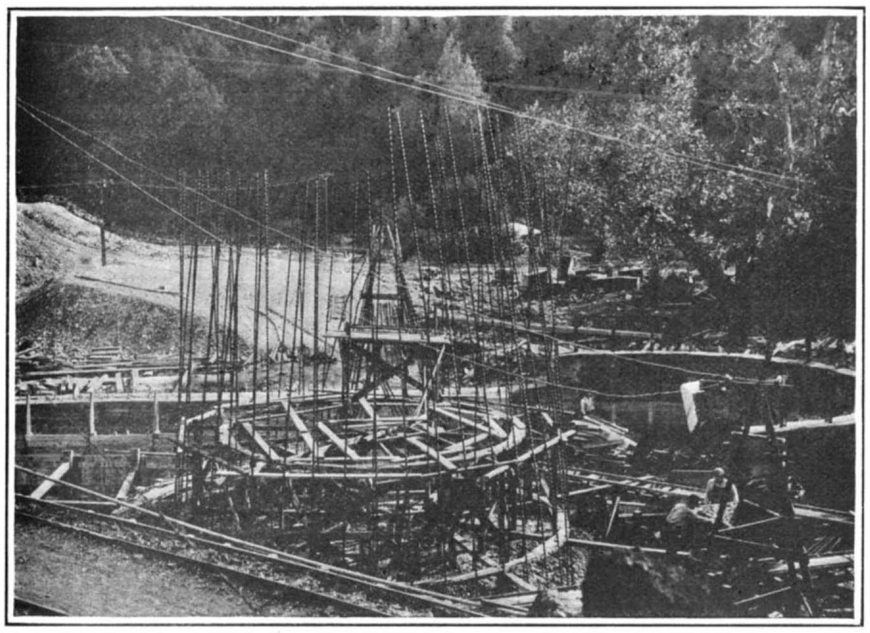
## Astronomy

**Intensity of the Sunset Afterglow.**—In watching the western sky after sunset one receives the impression of an increasing intensity in the rosy glow for a time, followed by a diminution of intensity. This is, however, an illusion, as shown by photometric measurements recently executed by P. Gruner in Switzerland. He found that the glow of the western sky steadily diminishes after sunset, but not at the same rate as the light of the sky midway between the horizon and the zenith. The latter at first decreases more rapidly in intensity than the sunset glow, and then less rapidly. Hence, the apparent increase in the intensity of the sunset glow is an effect of contrast with the illumination of the sky at a distance from the horizon.

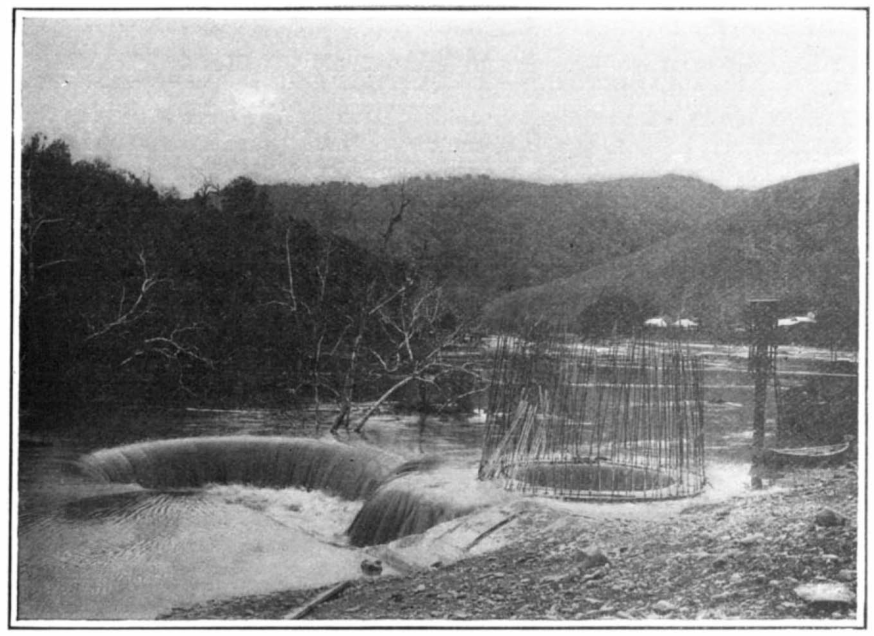
**New Stars.**—Some of the phenomena presented by so-called "new stars" at a late stage in their history have been recently investigated. It was generally thought that these stars, in their last stages, presented a nebular spectrum, but in 1907 Hartmann directed attention to the case of Nova Persei (1901), the spectrum of which, in its later stages, no longer presented the chief nebular lines. It is interesting to determine whether all novae behave in this manner. As the result of a number of observations it is suggested that this is indeed the case, a close correspondence being pointed out between the stars called Wolf-Rayet stars and temporary stars in the later stages of their history. The hypothesis that the phenomenon of a temporary star is due to a star entering a nebula is deserving of some attention, since the disappearance of the chief nebula lines is coincident with the emergence of the stars from the nebula.

**Photographic Telescope for Yale Observatory.**—The last annual report of the observatory of Yale University describes the new instrument for parallax investigations now being installed at that observatory to replace the 6-inch heliometer heretofore used for such observations. It consists of a photographic telescope of 15 inches aperture and 50 feet focal length, to be mounted parallel to the earth's axis of rotation. Light from the celestial bodies will be reflected upon the lens from a 30-inch silver-on-glass mirror, carried by an equatorial mounting. This mirror will also direct the rays of light to another lens of 10 inches aperture, mounted close beside the photographic lens and having the same focal length, thus serving as the objective of the guiding telescope. The star images in the field will of course revolve about the axis of the lens, and means have been provided for rotating the photographic plate-carrier at the rate of the earth's diurnal rotation.

**Measuring Stellar Radiation.**—The development of apparatus for the exceedingly delicate work of measuring the radiation from the stars continues to occupy the attention of the U. S. Bureau of Standards. The latest achievements in this direction are reported by W. W. Coblentz in the *Journal* of the Franklin Institute. He finds that there is little difference in the radiation sensitivity of stellar thermocouples constructed of bismuth-platinum, and those of bismuth-bismuth+tin alloy, which have a 50 per cent higher thermo-electric power. A recent improvement is a method of maintaining a vacuum by the use of metallic calcium, so that the observing apparatus may be taken to the most remote places without carrying along an expensive vacuum pump. Dr. Coblentz has used his instrument in measuring the radiation from 112 celestial objects, including the bright and dark bands of Jupiter, a pair of Jupiter satellites, the rings of Saturn, a planetary nebula, and 105 stars. Its remarkable sensitiveness is shown by the fact that quantitative measurements were made on stars down to the 5.3 magnitude, and good qualitative measurements down to the 6.7 magnitude. It was found that red stars emit from two to three times as much total radiation as blue stars of the same photometric magnitude (i. e., of the same brightness). The principal object of these observations was to ascertain what sensitivity would be required in order to be able to observe spectral energy curves of stars. The present apparatus is so sensitive that, when combined with a 3-foot reflecting telescope, it should give a galvanometer deflection of 1 millimeter when exposed to a candle placed at a distance of 53 miles. It will, however, be necessary to have apparatus about 100 times as sensitive as this in order to do much valuable work on stellar spectral energy curves—and this increase in sensitivity is said to be possible! Such an instrument would be sufficiently sensitive to detect the radiation from a candle placed at a distance of 500 miles, assuming the rays not to be absorbed in passing through the intervening space. The writer also describes measurements made to determine the amount of stellar radiation falling on a square centimeter of the earth's surface. This is so minute that the radiation from Polaris falling upon the area in question would need to be absorbed and conserved continuously for a period of 1,000,000 years in order to raise the temperature of 1 gramme of water 1 deg. Cent.; while that of all the stars would require from 100 to 200 years. The sun's rays are found to furnish the same amount of heat in about one minute.



At work on the upstream end of the storm-water culvert. The gate tower under construction in the foreground.



Flood waters pouring into the intake of the big storm-water culvert leading under the dam.

# Hydraulic Fill Dam for an Earthquake Region

## Work on the Calaveras Reservoir of the San Francisco Water Supply

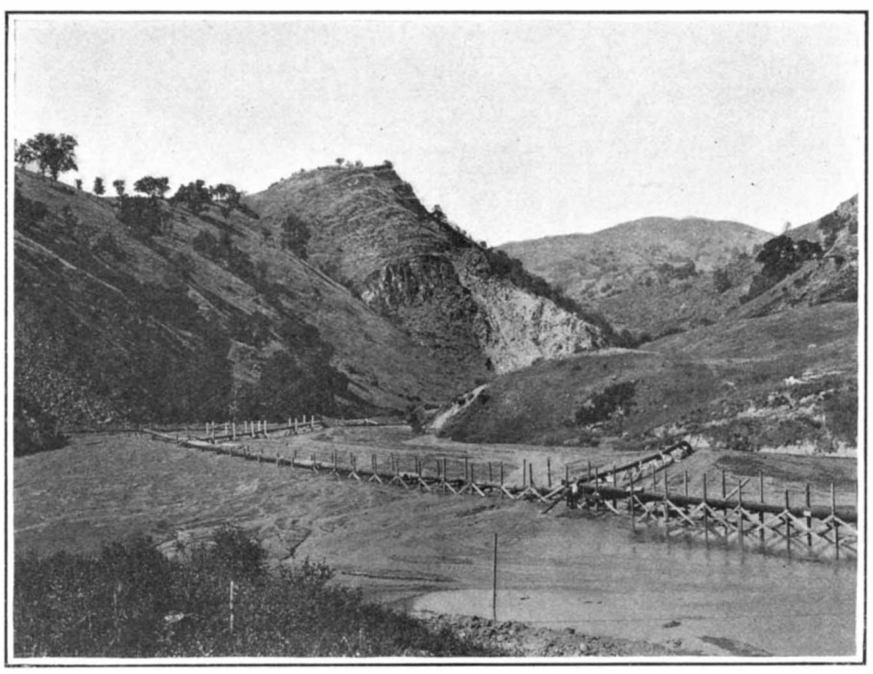
AT the time of the great San Francisco earthquake of 1906, the San Andreas rift, with a lateral movement of eight feet, passed through two dams without doing any damage. Had the dams been of concrete, undoubtedly they would have been shattered and would have plunged a flood upon the surrounding country. But they were made of earth, and yielded to the quaking without parting. In regions subject to seismic disturbances this is the only safe type of dam to build. Thus, at the Panama Canal we have, in place of a concrete barrier, an enormous hill of earth to retain the waters of the big Gatun Lake. A similar dam on a smaller scale is now under construction at the Calaveras Reservoir, about thirty-six miles southeast of San Francisco, where a mountain stream, which in time of storms swells to torrential proportions, is being dammed to provide a reservoir that will augment the water supply of San Francisco. The dam will rise 220 feet above the bed of the stream or 240 feet above bed rock. It will be a quarter of a mile wide at the base, or 1,312 feet, to be exact, tapering to a width of 25 feet at the crest, while its length at the crest will be 1,250 feet. Altogether there will be 3,100,000 cubic yards of material in the dam. The upstream face of the dam will be paved with concrete.

Owing to its enormous size, several years will be required to complete the work, and the matter which called for immediate attention on the part of the engineers was a means of passing the flood waters during the period of construction. The first work consisted in diverting the stream from its bed by means of a temporary dam and a waste flume running along the hillside. The capacity of the flume was sufficient to carry off the summer flow. This done, work was immediately started on a storm culvert a quarter of a mile long, running down the bed of the stream from the upper toe through the entire dam site. This culvert is of horseshoe shape with a cross-sectional area equivalent to that of a circle twenty feet in diameter. The first work consisted in placing the invert of the culvert, in which operation movable concrete mixers were employed. Twenty-six thousand two hundred and forty cubic yards of material were excavated for the culvert foundations, and in order to keep bed rock contact and retain grades, the invert was in some places 12 feet thick.

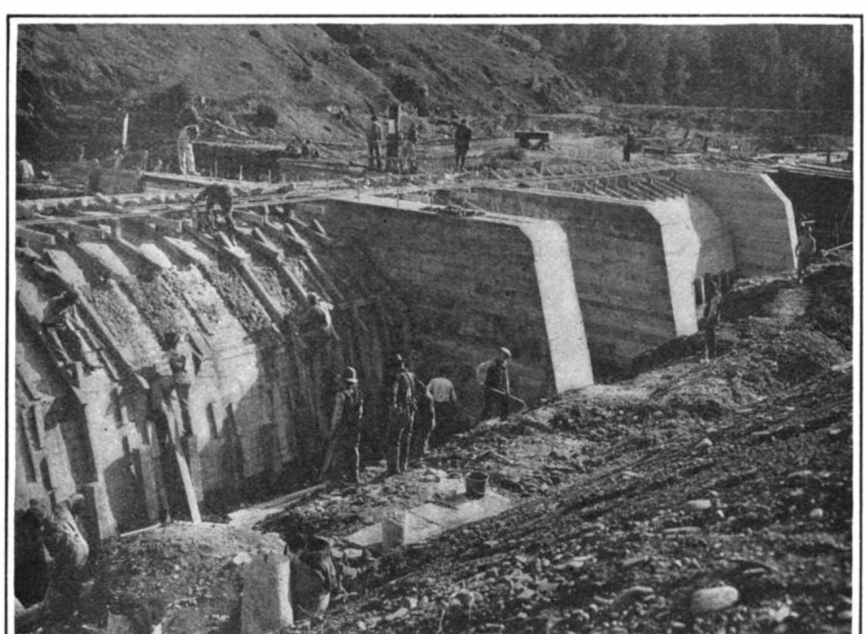
One of our photographs shows the work on the invert, while another shows the operation of building the arch. To prevent seepage along the conduit it was formed with "collars." The work was pushed with all haste during the time of low water, and was brought to completion in less than four months. For a large part of the time two ten-hour shifts were worked. The average amount of concrete laid per shift was 120 cubic yards, with a maximum of 400 cubic yards. Altogether 19,987 cubic yards of concrete was laid in the construction of the culvert and its appurtenances. At the entrance to the culvert there is a low circular weir 40 feet in diameter which may be raised by flashboards, when desired, to regulate the depth of the pond above the dam for hydraulic operation, in time of small flow.

The sluicing operations with which the dam is being built are of considerable interest. To prevent seepage under the dam, the overburden was removed, exposing bed rock for a strip 140 feet wide along the center line of the dam. All excavated material was placed in the upstream toe to form a barrier across the channel and divert the flood water through the culvert. Directly under the crest of the dam, a cut-off trench 25 feet wide and 8 feet deep was excavated, and as the work of filling the dam progresses, this cut-off trench is being carried up the sides of the canyon. The material placed in

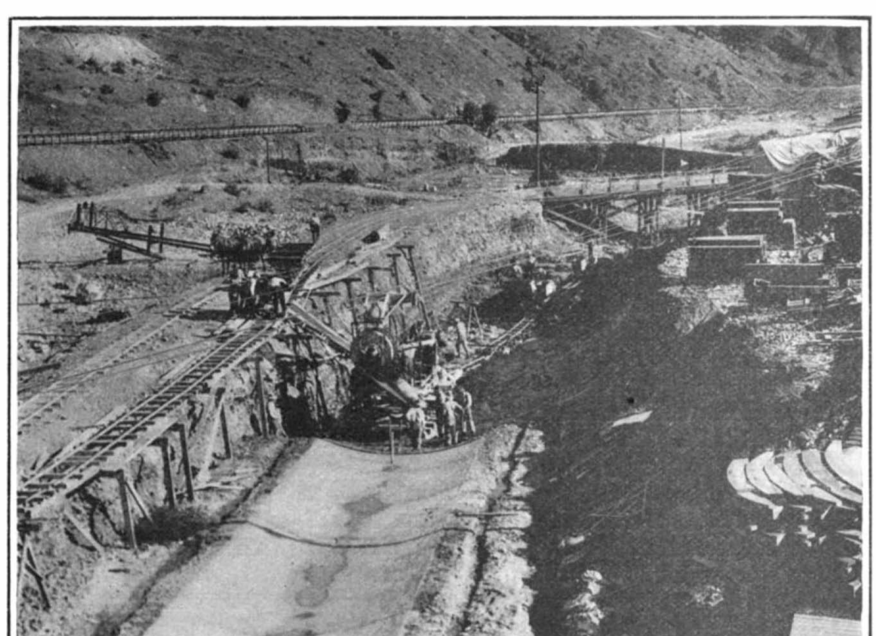
(Concluded on page 164.)



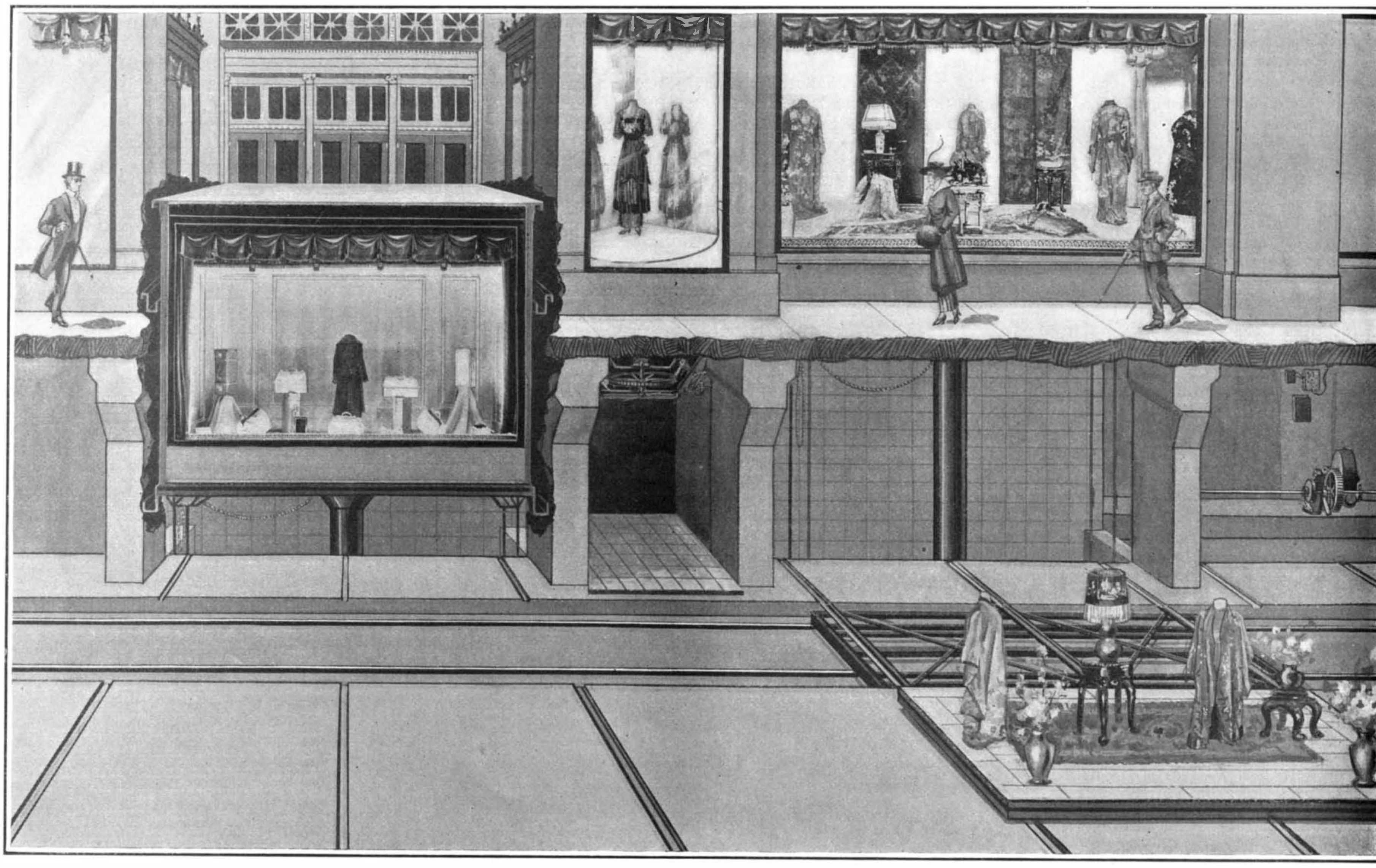
Discharging hydraulicked material at the downstream toe of the dam.



Forming the arch of the culvert. Note the "collars" to interrupt seepage.



Laying the invert of the storm-water culvert with a movable concrete mixer.



Elevator show window system, showing how the store entrance is closed at night by a display case.

# Using a Store Entrance for Night Displays

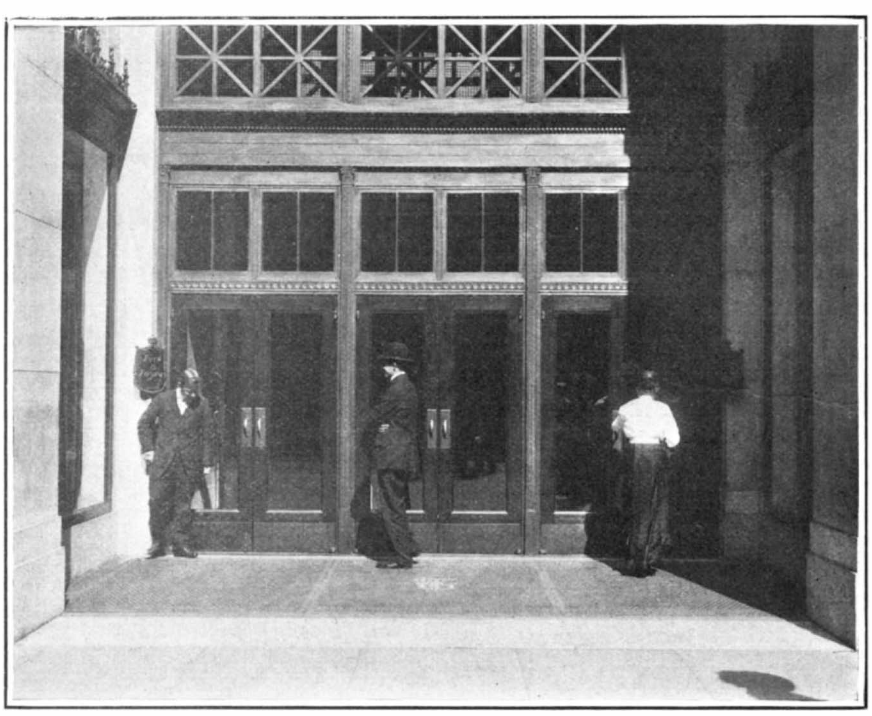
## Elevator Show Windows That are Dressed in the Basement

"A WINDOW display on Fifth Avenue is worth more than a page advertisement in all of the city's daily papers," said the buyer of a large New York department store, recently. He found that although such a display was not seen by so many people, it actually sold more goods. The window display is more in the nature of a class advertisement, because it is seen by those who are out to buy, and are interested in the very things exhibited in the show window. In addition to this it has a decided advantage over the advertisement in a daily paper. It requires a certain mental effort to construct from a word description and a black and white illustration a visual image of the goods that are for sale, and the appeal, no matter how cleverly worded, depends after all upon the ability of the reader to visualize the advertisement. In the show window, on the other hand, the goods are to be seen in actual life, in proper surroundings, in attractive settings and in a color scheme that it is impossible to reproduce in a newspaper.

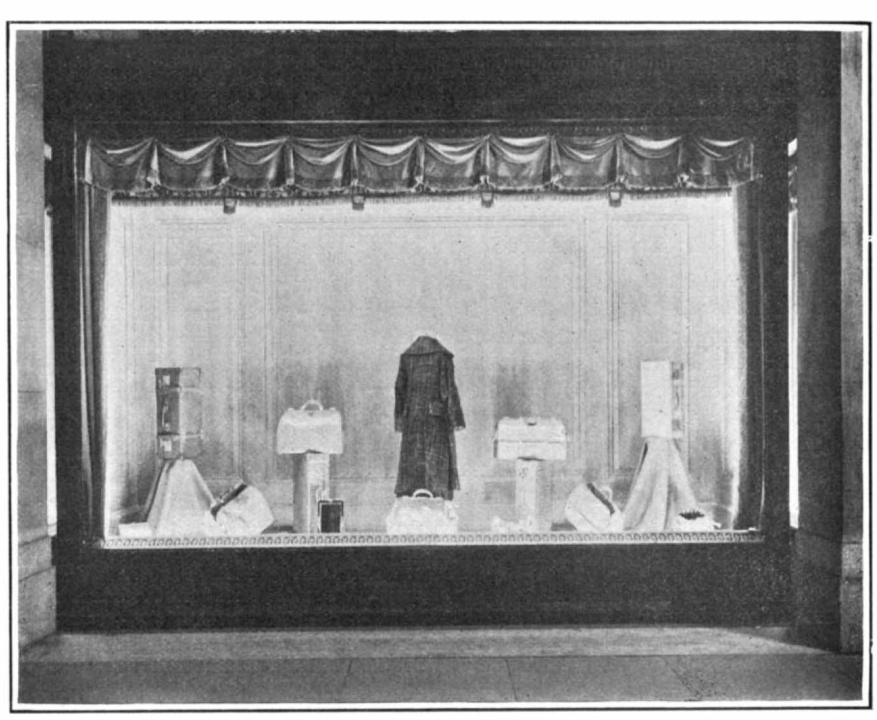
So valuable has show-window advertising become that even the space given up to the entrance of a store is begrudged. One of the latest of New York's Fifth Avenue stores, that of the firm of Lord & Taylor, actually uses the entrance for display purposes. During the day there is absolutely nothing to betray the novel construction of the open vestibule. But at the close of day, when the entrance is no longer of any use to customers, passersby may see the floor of the vestibule begin to rise and presently a completely dressed show window emerges from the basement and lines up with the rest of the windows. And during the evening pedestrians gaze at an unbroken row of show windows, and unless they know what has been done are puzzled at not finding the slightest evidence of an entrance anywhere. The vestibule showcase remains in position until well into the night, when the deserted avenue renders it no longer of any advertising value. Then it is lowered to permit of sweeping the entrance, cleaning the plate glass of the doors and polishing the brass work. Thus everything is prepared for the business of the following day, and in the morning customers enter the store oblivious of the fact that they are walking on the roof of a show window.

At the bottom of this page are two photographs taken from exactly the same spot, one of them exposed during the day time and the other at night with the show window in place. This illustrates how completely the entrance is transformed. The manner in which this is done is shown in the accompanying drawing, in which the entrance showcase appears in the act of being raised. A hydraulic plunger elevator is used for the purpose.

A difficulty that the architects had to contend with



Day view. The floor of the store entrance is the roof of a show window.



Night view photographed from the same spot. The show window completely hides the entrance.

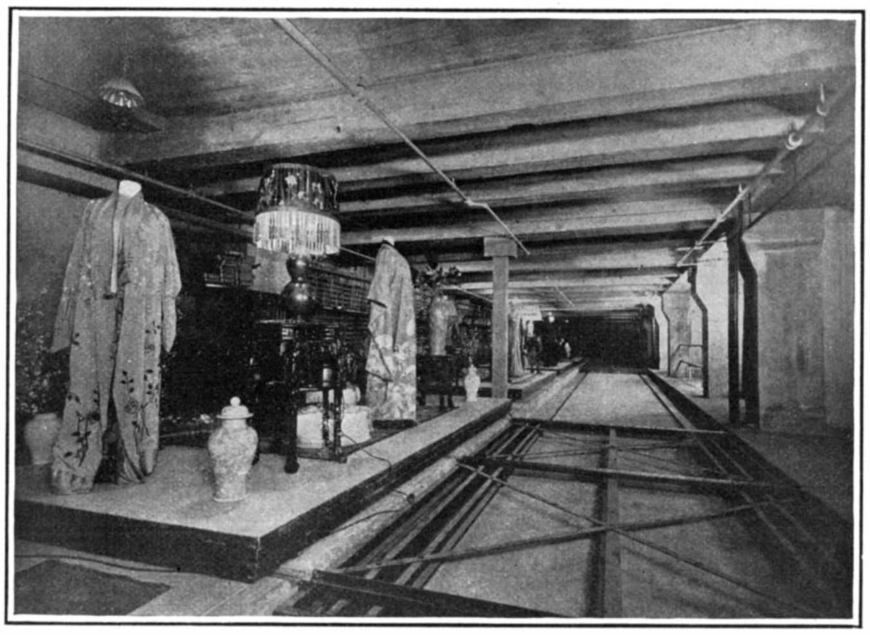
in designing this elevating showcase was that of leakage in rainy weather. Special gutters were designed to carry off the water that might leak around the edges of the showcase roof when in lowered position, and also to take care of leakage around the bottom of the showcase when in elevated position. The form of the gutters used is shown in the drawing. Fixed gutters run around the elevator well at the sidewalk level and are arranged to fit under the eaves of the showcase roof when the latter is lowered. At the bottom of the show window are other larger gutters arranged to fit under the fixed gutters when the showcase is raised and trap leakage past the fixed gutters. This system has proved effective in keeping an absolutely dry basement.

Not only is advantage taken of the entrance space, but at each side of the entrance are two narrower show windows with revolving floors or turntables. Each window may be divided by radial panels attached to the turntable, into four compartments, so that four displays may be made in the same window. The mechanism that operates the turntable is arranged to arrest the turning movement as each display comes into view, and hold it there for a minute or so, after which the table turns sufficiently to bring the next display into view.

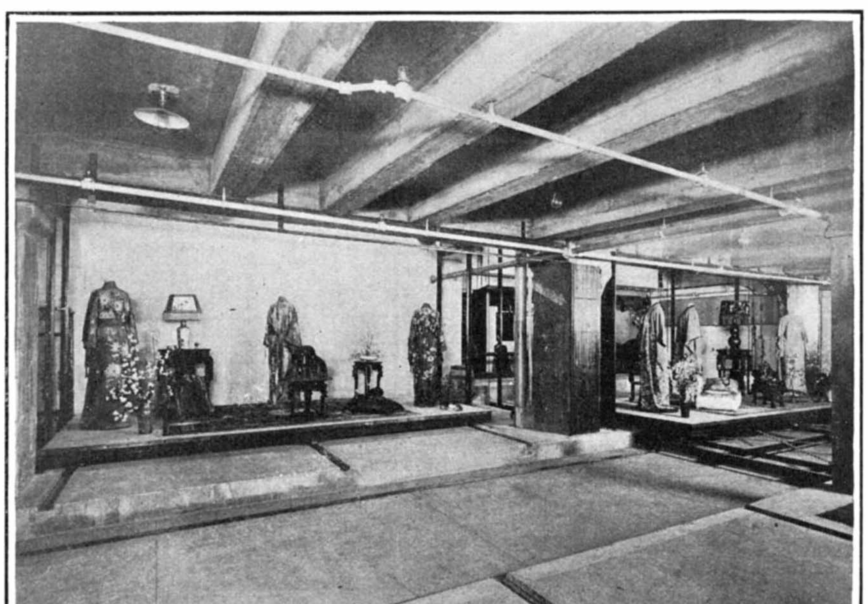
At each side of these revolving cases are two long show windows which, like that of the entrance, are arranged to be lowered into the basement where the window dresser may arrange his display. The window dresser's chamber extends under the sidewalk along the entire front of the store and is well illumined in the daytime by sidewalk lights. Extending down the entire length of this chamber is a trackway on which a bridge or truck may run. Running transversely are trackways adapted to receive window platforms mounted on rollers. The longitudinal trackway is sunk beneath the floor level so that a window platform may be moved out upon the truck, and after being carried down the trackway to any desired window elevator, be moved on to the elevator and raised into the show window. Ample space is provided for a number of these platforms in addition to those on display in the show windows, so that the window dresser may prepare his entire set of displays in the basement in daylight and note their effect. After a complete set of displays has been prepared, the elevators are operated to lower the window displays, which are quickly moved off upon the transfer truck and shunted out of the way, while the new displays take their place. The advantage of this arrangement is that it reduces night work, which has heretofore been unavoidable; practically all the work is done during daylight hours, and only the work of exchanging the new for the old displays need be done at night.

All the elevating show windows use a hydraulic plunger elevator, except the one shown at the extreme right of our drawing. There is a driveway that passes under this portion of the building, making it impossible to use a plunger elevator, and hence an electric elevator is used instead.

Altogether the system is most unique, and is an excellent example of efficiency engineering as applied to store construction. We are indebted to the architects, Messrs. Starrett & Van Vleck, for details of the construction.



**The window dressers' room under the sidewalk, showing the transfer system.**



**Window displays are prepared at leisure and transferred to the show window elevators.**

## Military Air Scouting by Motion Pictures

**By Ernest A. Dench**

Who would have thought that motion pictures could be sufficiently adaptable to prove an efficient aid to army aviators in their scouting work? Yet it is so, thus testifying to the versatility of the film.

Prior to this war experiments had been carried out by Germany, United States, and Great Britain. However, Germany, down to the present time, appears to be the only nation to graduate the idea out of the experimental stage.

Their aviators make it their business to fly over the enemy's location at a great height and to film everything likely to facilitate their attack. The negative is then developed and a positive print printed from the same—the Germans having made special provision for this—and a few hours later the picture is thrown on the screen in the German camp. The commanding officers scrutinize the film with the object of discovering the weak points in the enemy's position, which they lose no time in firing upon. I have it on excellent authority that the motion picture has been directly responsible for a number of the German victories since it has rendered it possible for them to advance in the right direction without the likelihood of the men falling into a trap. Additionally, no appreciable amount of time has been lost in taking the decisive step. The new plan is much safer and more reliable than is spying in the ordinary way.

As to the nature of the special processes by which the pictures are taken, it is a carefully guarded secret. It is stated to be the invention of a German cinematographer who was so patriotic that he disposed of the exclusive rights to the German government about two years ago.

What has stood in the way of movie air scouting being adopted has been the bluriness which mars the films that are produced above while the flying machine is traveling at a rapid pace. Second, the earth has not been sufficiently close for the essential things to be distinguished adequately enough.

In conversation with an English motion picture photographer of high standing, he firmly believes he has succeeded in untying the strings of mystery which surround the German invention.

It is his contention that to control the speed of the swiftly moving aeroplane with the lens of the camera, the inventor has contrived a self-operating camera. The "release" of the film is manipulated by wind while the machine is in motion. When the wind coming in the opposite direction strikes a tiny fan contrivance at the side of the camera, it automatically turns the crank, which then unwinds the film on which everything is recorded in due course. The clockworklike device alone causes the pictures to be photographed at a normal speed.

It also enables the movie-airman to concentrate his energies on controlling the aeroplane, for the only thing he has to do is to release a small lever in order to free the "wind arm."

Apart from this, a powerful lens has evidently been devised, affording a far greater field of vision than is possessed by motion picture cameras already in use. Not only does this permit the operator to soar higher in the air, but makes the pictures seem as though they were filmed just a trifle above ground.

In 1912 Lieut. F. N. Kennedy of the United States Army conducted experiments with the motion picture scouting work. He began the journey from College Park with the assistance of Lieut. Arnold. From an altitude of 1,500 feet he turned the lens toward the road below, shifting it but slightly from one side to the other to cover it properly.

"The one great difficulty," he said, in an interview accorded him at the time, "we encountered—but it is one which can easily be remedied—was in definitely deciding how much territory we were covering."

The British Army Council experimented in rather a unique way. They hired an operator to do some filming from the car of the airship "Beta." The test was this: The Inniskilling Fusiliers had to pretend to be a raiding party. While trespassing in the enemy's territory they endeavored to escape detection from the aerial scouts of the foe. The aviators were aware that their hiding place was somewhere below them and the soldiers could only save themslves by selecting places where the soil or foliage matched their khaki uniform. This was done to determine whether objects are visible against vari-colored background.

## Steel Darts

The steel darts used by the French aviators have proved an effective weapon. They are light in weight, running according to size from 45 to 66 per kilogramme (a little over 2 pounds), and owing to their buoyancy are liable to drift with the wind. On this account they are mainly used against extended objects, such as bivouacs in the open, columns on the march, etc. Their effect can always be judged by the commotion caused among the groups of infantry or cavalry, horses especially are terrified by them, and this confusion serves as a guide for the aim of the airman. The reasons given for placing the name of the adjutant aviator Mézergues on the list for the military medal show the prodigality with which they are thrown. The announcement states that in one day this pilot threw 18 bombs and 5,500 darts.

The French journal *l'Aerophile* in a brief account of these darts narrates several stories of their great power of penetration, which it quotes from an article in the German *Medizinische Wochenschrift* by a German physician, Dr. Volkmann. The physician says that a German soldier was killed at once by a dart which struck him on the head. Another soldier was struck on the shoulder by a dart that traversed the chest and was only checked by the hip-bone; the unfortunate man died in a couple of days. Many other soldiers have been literally nailed to the ground by the feet. He calls the dart thrown from aeroplanes a very dangerous weapon, for the wounds produced by these darts nearly always prove mortal. It was a dart shot from a French aeroplane which killed the Bavarian general, von Meyer, as he was stepping into his automobile. The French darts are arranged in groups of 500 in special distributors which the airman works when his sighter shows that he has reached the spot where they should be launched. There are even times when the aviator simply throws the darts by hand in fistfuls. Success depends more on quickness of eye and the training of the airman than on the scientific construction of the sighting device.

## An Engineering Foundation

Usually any funds given for the advancement of an art or science are put in charge of some institution of learning, but a notable departure from such precedents was made at a combined meeting in New York on the evening of January 29th of the United Engineering Society, representing the American Institute of Mining Engineers, the American Society of Mechanical Engineers, and the American Institute of Electrical Engineers, in combination with the American Society of Civil Engineers, when it was announced that Ambrose Swasey of Cleveland had donated the sum of $200,000 as an initial gift toward a foundation for the advancement of Engineering Arts and Sciences. This foundation is for the promotion of the greatest good of the engineering profession generally and the benefit of mankind. The administration of the fund will be entrusted to a board of eleven trustees.

Mr. Swasey, who has inaugurated this important movement, is of the firm of Warner & Swasey, who built the Lick, Yerkes and many other telescopes, and is himself a well-known engineer and a member of many prominent engineering and scientific societies.

# Doing Without Europe—III

## How the War Has Affected Our Mineral and Metal Industries and How We May Profit

*This is to be regarded as the second installment of the argument which was begun in the last issue of the* Scientific American. *Our object is to show how vast are our own mineral and metal resources and how comparatively little we have done with them. Particularly inspiring is the work done by a paint manufacturer to render himself independent of European barium. Interesting too is the Government's effort to free us from the control of the German potash syndicate.*—Editors.

### The Slump in Copper.

The copper industry has probably felt the injurious effects of the European war more seriously than any other of the leading American metal industries. About 50 per cent of our copper has been exported almost entirely to the countries now involved in the European war. While much copper is, of course, consumed in the manufacture of war material, the more constructive arts of peace are far more favorable for the copper industry. We have contented ourselves with exporting the metal in pigs, ingots, bars, plates, sheets, rods, and wire. Europe takes our copper and manufactures it into useful articles worth many times the value of the copper which is bought from us. Obviously, the opportunity for the American manufacturer lies in entering the foreign markets that were supplied by European exports of manufactured goods. European competition is, temporarily at least, destroyed and the low price for the crude material is such that manufacturers would find in copper products a wonderful field for development.

What little arsenic we make ourselves is a by-product from copper and precious metal smelters. We import large quantities from Europe. The American smelters can save much more arsenic than they do now, for the cheapness of the product has prevented the saving of all that was practicable. Although it is difficult for plants exclusively producing arsenic to compete with the by-product of the smelters except in periods of high prices, nevertheless there are two plants in the United States, at Brenton, Virginia, and Mineral, Washington.

### The Beginning of a Barium Industry.

Barytes has a wide variety of uses in the manufacture of paint, lithopone, wall-paper, glass, artificial ivory, insecticides, fertilizers, and the like. The largest consumers of barytes are the manufacturers of "ready-mixed" paint and of lithopone. Since the outbreak of the war in Europe many American users of foreign barytes have been forced to look at home for their future supplies.

About two weeks after the European war started, Mr. Maximilian Toch of New York city, a chemist whose life has been spent in improving paints, came to the conclusion that the barium salts which had always been imported from Germany and which were largely used in the rubber, paper, and paint industries of the United States, would have to be made in this country if his firm was to continue in business. His first step was to cast about for a pure barium ore. He found in Tennessee the only ore within shipping distance from the coast, conveniently situated relatively to railroads and waterways. Moreover, the barite ore of other localities contained lime and fluorine, both fatal to the manufacture of certain chemicals. On the 5th of October last, Mr. Toch bought an old plant and began to rebuild it at once. On the 15th of November he turned out his first carload of barium carbonate, barium sulphate, and barium chloride. Since then about fifteen tons of various materials have been manufactured per day, including sodium sulphide crystals and concentrated, precipitated barium sulphate, barium nitrate, and barium carbonate. Although it has been in existence only a few months, the plant has been unable to meet the demand. Its enlargement is a matter of immediate necessity. Thus has the war established the first successful barium industry in the United States.

The question arises how this plant will fare when the war is over and the Germans are once more able to enter our market. Mr. Toch holds that the German ore is no cheaper than ours, nor are German freights lower. German coal is dearer. Germans have been able to make chloride of barium cheaper than Americans because they have native carbonate and by-product hydrochloric acid. On the other hand, we have other advantages. Our sodium sulphide is of a high grade, which enables us to market our other products at a lower rate. With the new German war tax and the high freight rates and the general expensive conditions, Mr. Toch sees no reason to fear German competition.

### The Heavy Chemicals.

If so important a mineral as barytes can be utilized, as Mr. Toch has so daringly demonstrated is possible, what may not be expected of a heavy chemical industry?

"The successful introduction into this country of the Solvay process, some years ago, for treating salt, and the later process for the decomposition of salt by electricity has practically driven from the American market the importations of most forms of soda and bleaching powder," says Mr. J. Russell Marble of the J. Russell Marble Company. His statement is significant because the enormous soda plant of the Solvay Brothers in Belgium has been destroyed. France or Germany cannot export soda to this country, and the English plants are running at only one half capacity because their employees have enlisted.

"Our opportunity in this soda field is brilliant. Fortunately for this country," Mr. Marble summarizes the situation, "we have enormous deposits of salt chiefly located in northern New York State, under the city of Detroit and in Kansas and Louisiana, and we have immense water-powers from which electricity can be generated. The manufacture of various forms of soda has been especially successful in this country during the last twenty years, and the effect of the European war, in my judgment, will call for very large shipments of these chemicals to the Mediterranean, Australia, South Africa and South America, and this should lead to the running of the plants in this country to their fullest capacity, so that the immediate effect of the war on the heavy chemical industry will undoubtedly lead to a larger output, to higher prices, and to a more profitable business for the American manufacturer."

Magnesite or carbonate of magnesia finds an extensive use in the manufacture of brick, furnace hearths, crucibles, in the digestion and whitening of wood pulp paper (for which purpose it must be transformed into magnesium sulphite), in the manufacture of crude carbon dioxide, for making oxychloride or Sorel cement, and in the making of refined magnesium salts. We have deposits of magnesite in this country, but they are located in California, far from the eastern markets. It may be that the opening of the Panama Canal will cheapen transportation to such an extent that we may no longer be dependent upon Europe—a suggestion thrown out by a committee appointed by the New York Section of the American Chemical Society to consider the relation of the war to industrial chemistry.

The same committee finds that acetic anhydride can be made without trouble in this country. Ammonia and its salts all depend upon recovery coke ovens, the number of which is increasing as fast as circumstances will permit. Yellow prussiate and sodium cyanide can be and have been made from domestic materials in such an amount as to provide practically the entire home consumption or a great portion of it so long as there was a sufficient duty on them; but the present duty is not enough to protect the American manufacturer and those who engaged in the business soon found it impossible to continue. Hydrosulphites in solution and oxalic acid can be made from domestic materials. Tartaric acid and citric acid can also be made, but radical changes are called for on the part of our grape growers and our lemon growers to meet the requirements of the chemist.

The only mineral substance which has engaged the attention of Congress so far that it has set aside money to study its development scientifically in the United States is potash. Fortunately for us this governmental research was set on foot before the present war. We owe this congressional activity to two circumstances—the controversy started by the German Kali Syndicate a few years ago and the utter dependence of our farmers upon Germany for their potash fertilizers. It was the farmer who roused Congress—the farmer with a vote—not the manufacturer dependent on Europe.

### Potash and the War.

The war has served to accentuate this subjugation and to drive home the absolute necessity of rendering us independent of the great Stassfurt potash deposits. All the industries dependent upon potash have been affected. Lower grades of potash which would ordinarily find their use in fertilizers are bought up by glass makers and potters. Some manufacturers have even substituted soda for potash in glass-making.

Few of us realize how all-important is potash, not only in agriculture, but in industry. It is the chief ingredient of many fertilizers. Its salts are used in the manufacture of glass, explosive powders, certain kinds of soap, and in mechanical industries, including the manufacture of alum, cyanides, bleaching powders, dyestuffs, and other chemicals, among which are arsenite of potassium, bromide of potassium, chlorite of potassium, permanganate and manganate of potassium, nitrate of potassium, silicate of potassium, etc. The chemical manufactures alone dependent upon German potash salts are of enormous magnitude. Potash alum is extensively used in the dyeing industry and by paper makers and leather dressers.

Can we become independent of Germany for potash? The annual imports of potash salts during the past three years have averaged about 635,000,000 pounds in quantity, and $11,000,000 in value. These figures, however, represent only a part of the potash salts entering the United States, as they do not include the imports of fertilizers. The quantity of materials of this class imported for consumption during the last three years has averaged about seven hundred thousand tons, valued at $4,300,000 annually. Thus, it is apparent that the value of the annual imports of potash salts exceeds $15,000,000.

### Our Own Potash Supply.

There is a natural deposit at Searles Lake, California, of some 4,000,000 tons, equivalent to a few years' supply for fertilizer alone. The Government performed a valuable service not only in calling attention to Searles Lake, but in scientifically studying the region at great expense for industrial development. Partly as the result of this governmental interest an experimental plant has been built at Searles Lake. Its success or failure will be watched with interest. The Government has found that in Oklahoma there is a possible source of sulphate of potash; and that in Texas there is potash about 2,200 feet below the surface. Alunite, yielding after treatment about 18 per cent potash sulphate, is deposited in Utah, Colorado, Nevada, and Arizona.

But the great source of potash is the felspar and granite rocks of New England. Many of them contain from 8 to 12 per cent of potash. As yet no commercial process has been perfected for rendering this potash quickly available to plants. Mr. W. H. Bowker, whose connection with the American Agricultural Chemical Company enables him to speak with authority, says:

"There is a great fortune awaiting the man who can invent a feasible and cheap process, but the potash must be soluble in water, and it should be produced at a cost not exceeding $20 a ton (on the basis of muriate) laid down in the Eastern markets, for if put to it, the Germans could sell their potash at that price in this market and even for less."

### The Powerful German Potash Syndicate.

This leads one to inquire into the German situation. The Stassfurt mines can raise and refine the mineral for $8 a ton. The price in cargo lots varies from $35 to $34 a ton, delivered at seaboard. The German Kali Syndicate sees to it that a handsome profit is maintained by limiting the production of the mines and by fixing the price arbitrarily. Prof. H. A. Huston, who is said to take care of the Kali propaganda in our Eastern and Southern States, has been quoted as saying:

"We have one hundred and ninety mines, forty of which would supply the world very nicely. We are prepared for almost any sort of emergency demand."

If the situation is thus correctly pictured, if Germany can release large quantities of potash when the war is over, simply by raising the embargo on production placed on the mines by the Kali Syndicate, aided by the Reichstag, what are the chances for an American potash industry?

The question is so important, both to agriculture and industry, that the United States Geological Survey has endeavored to locate deposits in this country and has followed up every clue that seemed to promise results of importance. And the Bureau of Soils of the Department of Agriculture has investigated the kelps.

### Kelp as a Source of Potash.

Probably the leading authority on the possibilities of kelp in this country is Mr. Frank K. Cameron of the United States Department of Agriculture. "The dried kelp," he tells us, "contains from 20 to 35 per cent, or occasionally even more, of potassium chloride, and is more desirable than manure salts or ordinary market grades of potash salts, not only because of its high content of potash, but because of the readily decomposable organic matter, a content of about 2.5 per cent nitrogen, and appreciable amounts of readily soluble phosphates, all of which give it an important fertilizer value.

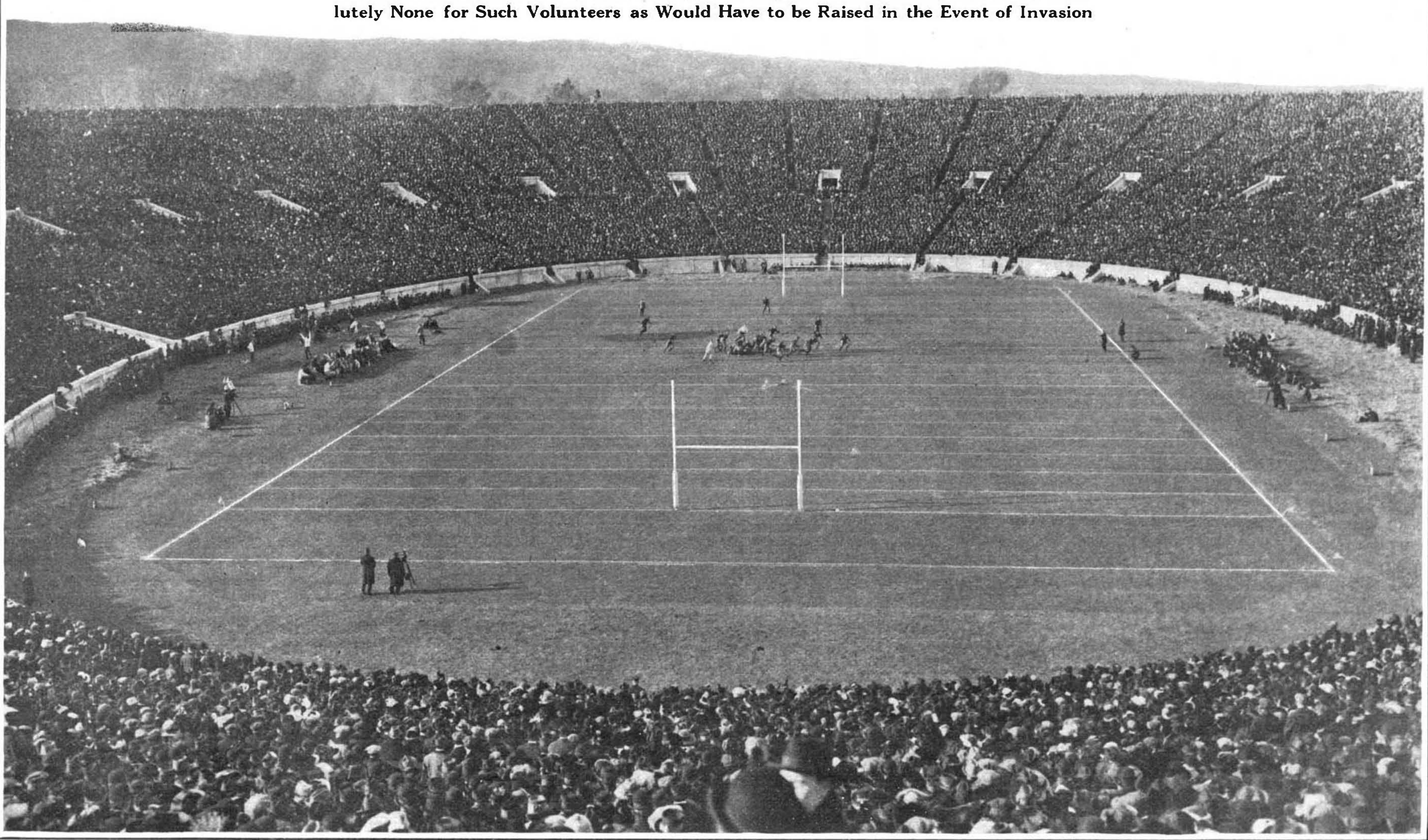
"The recovery of high-grade potassium chloride from the kelp is no more difficult than from the Stassfurt salts. The recovery of iodine and organic products, leaving a residual rich in potash, is quite feasible, but has not yet been attempted in this country, except on a laboratory scale, although now practised in Japan.

"The amount of potash salts obtainable annually from kelp cannot be stated at all satisfactorily at present. It is certainly large, and if careful supervision of the beds and harvesting be provided, it seems safe to as-

(*Concluded on page 164.*)

# II—The United States an Undefended Treasure Land

**We Are Short of Arms and Ammunition for Regulars and Militia, and Have Absolutely None for Such Volunteers as Would Have to be Raised in the Event of Invasion**



Copyright by Underwood & Underwood, N. Y.

**The Yale Bowl at New Haven, Conn.**

If the whole 90,000 effectives of the regulars and militia could be placed within the Yale Bowl, there would still be room for a game of football.

*[The second chapter of the series on the defenselessness of the United States shows our deplorable lack of the field guns, rifles, ammunition, uniforms, tents, transportation equipment and various supplies, without which Secretary Bryan's army of "a million volunteers" would be a mere mob of no military value whatsoever.*

*From President Washington to President Wilson, the Executive has persistently urged upon Congress the necessity of providing, in times of peace, a body of citizen soldiery properly trained and equipped, with which instantly to meet and repel any invasion of the United States. With equal persistency, Congress (except during periods of war) has refused to listen to the warnings of its Presidents. To-day, thanks to this neglect, the United States, the richest of the rich countries of the world, is the most open to invasion. The ocean, once a barrier, now, thanks to steam navigation, offers a choice of half-a-hundred highways, by way of any one of which a first-class power, in the event of the defeat of our fleet, might, within a week or ten days, land a fully equipped advance force of 200,000 highly-trained troops. To oppose this, the United States, in thirty days, could concentrate, at the most, 30,000 regulars and 60,000 militia.*

*The present series of articles is published with a view to bringing before the country at large and Congress in particular the true facts as regards the military defenselessness of the United States. They represent the result of weeks of study of the problem by the editorial staff of the* Scientific American, *in the course of which only the highest military officials and the latest official documents of the War Department have been consulted. What is Congress going to do about it?—* Editor.]

---

We have shown in the previous chapter that, in order successfully to meet an invasion, the United States require, in the early stages of the war, a mobile force (regulars, militia, and their reserves) of 500,000 men; whereas, as a matter of fact, we possess only 90,000 such troops to-day.

We now direct attention to the fact that we are without adequate artillery guns or ammunition for this combined regular and militia force, and it will be years, at the present rate of progress, before we accumulate the guns and ammunition necessary for this combined force at war strength. The estimate on which the Department has been working is for 1,292 guns, and 634 of these guns are actually completed; also 226 others are under contract. Of field artillery ammunition, there is only a small percentage of the total amount required.

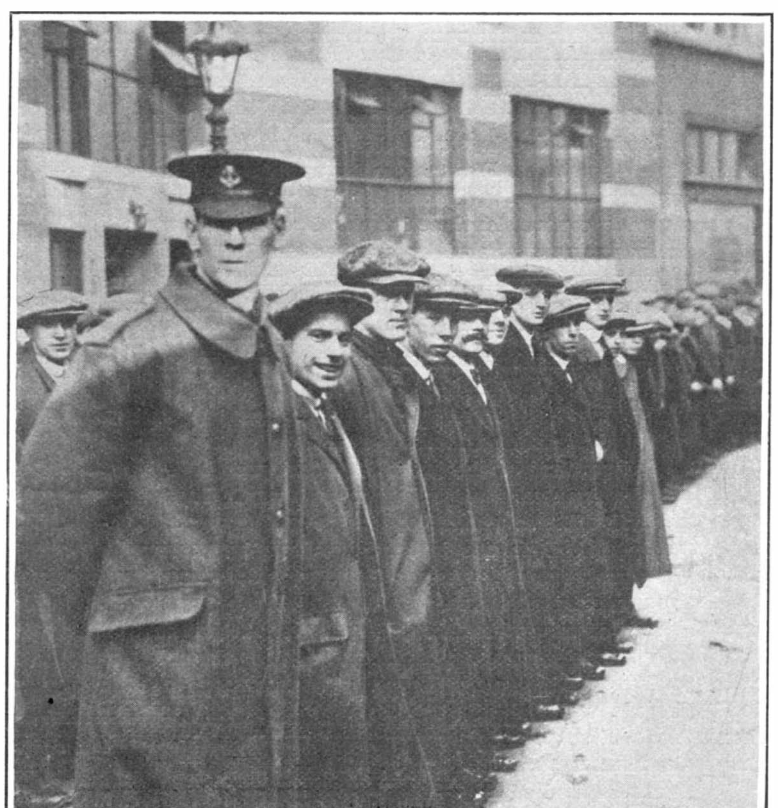
**Lack of Field Artillery Guns and Ammunition.**

We have in the hands of troops, or stored, 634 completed guns. We have under manufacture or contract, 226. These guns will probably not be completed for at least a year and a half. In other words, the number of completed guns is a little less than half the total number deemed necessary for the field force of 500,000 men, and provides no guns whatever for the coastguard troops or new volunteer organizations which will be required in addition to the 500,000 field force. Of ammunition, we have, made and under contract, approximately 30 per cent for the entire project of guns (1,292). Half of this is under manufacture or contract, so that there is not more than 15 per cent actually completed. For the guns on hand and under manufacture we have, of ammunition on hand and under manufacture, about 41 per cent; actually on hand, approximately, 20.5 per cent. For the guns actually made (634) we have 27 per cent of the ammunition necessary. For the guns now in the hands of the regular army and militia we have about 44 per cent of the ammunition necessary. It should be remembered, however, that the guns in the hands of the regular army and militia at the present time are less than half the guns required for these forces when properly equipped with guns, even under our scheme for the assignment of guns and ammunition; which is in both instances far lower than in any of the great armies to-day, and the present war has indicated, in the case of one great power at least, that the consumption of ammunition has exceeded twice their maximum estimates, and that the proportion of artillery will, in future, be increased.

At the rate of even last year's appropriations, which were the largest made for field artillery guns and ammunition, it will take between eight and nine years to complete our present modest estimate for guns and ammunition, and the necessary equipment in the way of ammunition trains and other accessories.

**We Have Absolutely No Artillery for the Needed Volunteer Coastguard Force of 380,000 Volunteers or the Vast Volunteer *Mobile* Forces that Would Have to Be Raised Back of Our Front Line.**

This total number of guns, 1,292, represents practically only enough guns for the field force of 500,000 men made up of the regular army and the militia brought to war strength and with necessary new organizations. It does not provide a single modern type field gun for the coastguard force or one for the great force of volunteers which will have to be promptly raised in time of war. These forces will be helpless against a well equipped enemy with artillery, and it can be assumed as certain that any attacking force will be fully equipped in all particulars. Is this haphazard policy either just or fair to our volunteers? Are they not entitled to such equipment as will give them a fighting chance? No adequate steps are being taken to provide it. The present entire gun-building resources of the United States, working day and night, could not make good our deficiencies in guns or ammunition within one and a half years; that is to say, within a period which would exceed that of



Copyright by Underwood & Underwood

**These men are recruits, not soldiers.**

It takes at least six months to make the one into the other.

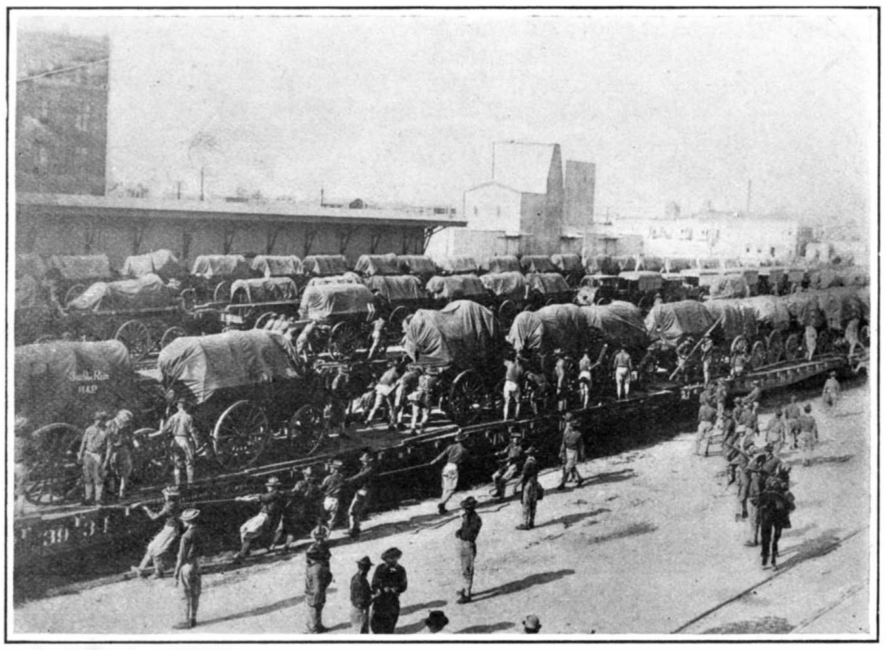


Photo. by Underwood & Underwood

**Troops entraining baggage wagons at Galveston.**


Copyright International News Service

**American outpost entrenched at Vera Cruz.**

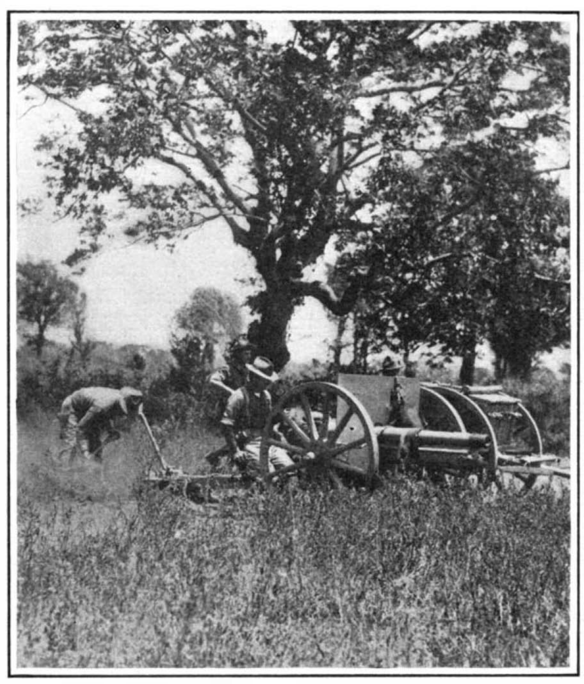
most modern wars and within the period which would in all probability determine the issue. These are plain and disagreeable facts. They cannot be controverted, and what is worse, there seems little inclination outside the army to make any effort to improve these conditions.

**During the First Few Months of a War of Defense Against a First-class Power We Would Require in Regular and Militia Field Forces, Coast Artillery, Coastguard Force, Volunteers, Etc., About 1,000,000 Men.**

The figures as to men required, for the field force and coast guard, represent in round numbers, including the coast artillery and its reserves, about 800,000 of men. regular, militia and volunteers, as the force which will be needed at the commencement and during the first few months of war—a million will be more nearly correct when all the demands of the situation are considered. When it is remembered that during the Civil War, when our population was about one third of what it is at present, we had, North and South, nearly 4,000,000 different men under arms and that we had about 1,200,000 North and South under arms at the end of the war, these figures do not seem to be unduly large. This statement shows what we have immediately available (90,000 mobile troops and about half the coast artillery required) and what we shall need in order that we may be reasonably well prepared to meet successfully the first shock of war with a first-class power, and it is only for preparation for conflict with such a power that we need particularly to concern ourselves. The little wars with little nations, we can take our own time to prepare for. In fact, our peace force, if we provide the necessary organizations to complete three tactical infantry divisions with their necessary artillery, three cavalry brigades, the necessary auxiliary troops, etc., within the continental limits of the United States, will generally be sufficient to furnish an expeditionary force for minor operations. The big wars with the fully equipped, strong nations, are the wars which threaten us and the ones for which we have made no preparation, worthy of the name.

**The Army Staff Asks for a Small Standing Army With a Large Trained Reserve of Regulars, Militia and Volunteers With Their Officers Back of It.**

The policy of the Army General Staff has not been for a large standing army, but for a standing army adequate for the police work of the day, i. e., an adequate garrison for the Philippines (20,000 men), a garrison for the Hawaiian Islands (16,000 men), for the Panama Canal (9,000 men), a small force for Porto Rico and Alaska, amounting to a regiment each, and the remainder within the limits of the continental United States. It has recommended that the regular army in the United States be increased, so as to provide three tactical infantry divisions in the continental United States, three cavalry brigades, and a division of army troops and a coast artillery force of approximately 19,000 men in time of peace. It has advocated a form of enlistment, under which men could be transferred to the reserve as soon as they were sufficiently trained and their places taken by others. Its recommendations have not been heeded by Congress, and upon the completion of our foreign garrisons, the regular forces in



Copyright by Underwood & Underwood

**American field gun in position.**

the United States will be sixteen regiments of infantry, with about 840 men per regiment, and eleven and two thirds regiments of cavalry, with about the same strength per regiment; three regiments of field artillery, with twenty-four guns per regiment, and certain auxiliary troops. Is this an adequate force for a population of nearly one hundred millions of people?

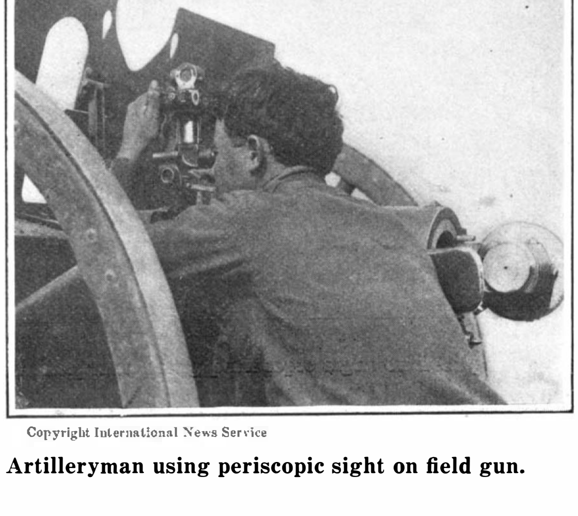
**Our Present Effective Field Army (Regulars and Militia) Could Be Put into the Yale Bowl and Leave Room for a Game of Football.**

The mobile troops in the United States, amounting to about three times the police force of the city of New York, taken with the *personnel* of that portion of the militia which is efficient and ready for service, can all be put into the Yale Bowl and room still be left for a game of football. Think of it! The total available mobile troops is less than one third the number estimated as needed for an adequate coast guard alone and only about one sixth of that needed for the field force, and no steps have been taken or are being taken to correct this alarming condition. No one who is familiar with the subject expects the country to maintain a force of the strength of that which would be needed in war on a war footing in time of peace; but they realize fully the necessity for making in the greatest detail all arrangements for preparing promptly the forces which will be needed in case of war, and especially do they realize the absolute necessity of having the regular army and the militia so maintained, both as to reserves and equipment, that they can be immediately brought to full strength, fully armed and equipped, and with reasonable reserve supplies. The necessity is also appreciated for completing, in advance, all arrangements for coastguard troops, because, as stated above, it will be destructive to the usefulness of the field force to attempt to take from it coastguard troops. Moreover, the demand for the coastguards will be such as to make it impossible to supply them from the regulars and militia, without entirely using up the available force of these troops.

**The Shortage in Small Arms.**

The reserve in the case of small arms is better than in any other detail of equipment, excepting small arms ammunition; but even in the case of small arms (service rifle) the amount available, 698,000, including guns made and under manufacture, is insufficient in view of the number of men which will be required for the field force, coastguard, and additions to the field force in the shape of volunteer organizations in the early stages of war. This force will undoubtedly steadily increase, and will increase at a pace which will be far beyond the capacity of the arms factories to meet. The wastage in small arms is always heavy. Many are broken, many are shot to pieces in action, many are lost through capture; they are bent, injured, and put out of commission in various ways. The reserve of small arms should be liberal—not less than a million and a quarter. The present policy of establishing a reserve of a million is barely sufficient to meet the demands of the first few months; and right here it may be well to point out the inadvisability of the Government attempting to manufacture exclusively its own military

*(Concluded on page 166.)*



Copyright International News Service

**Artilleryman using periscopic sight on field gun.**

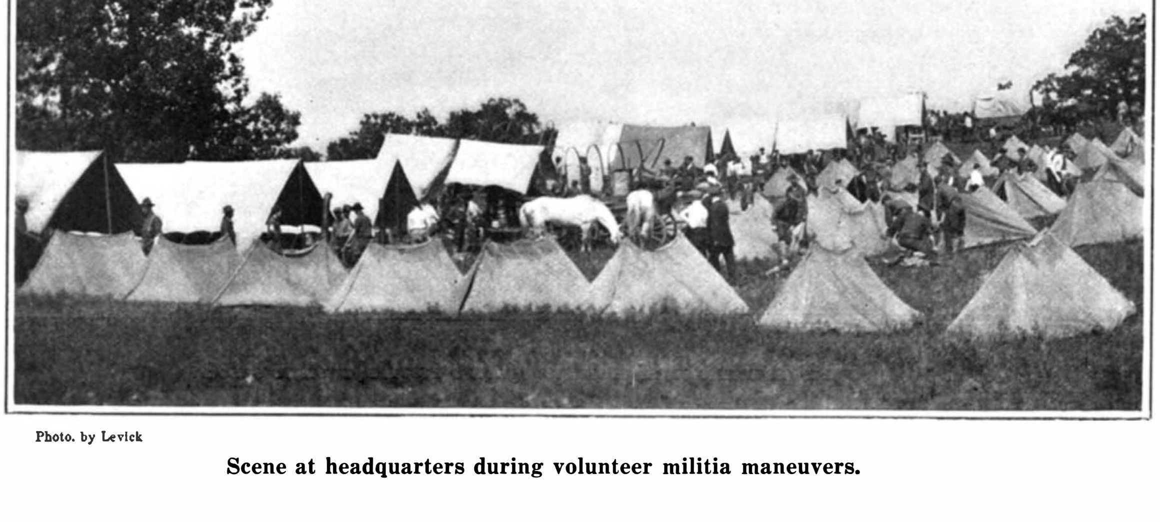
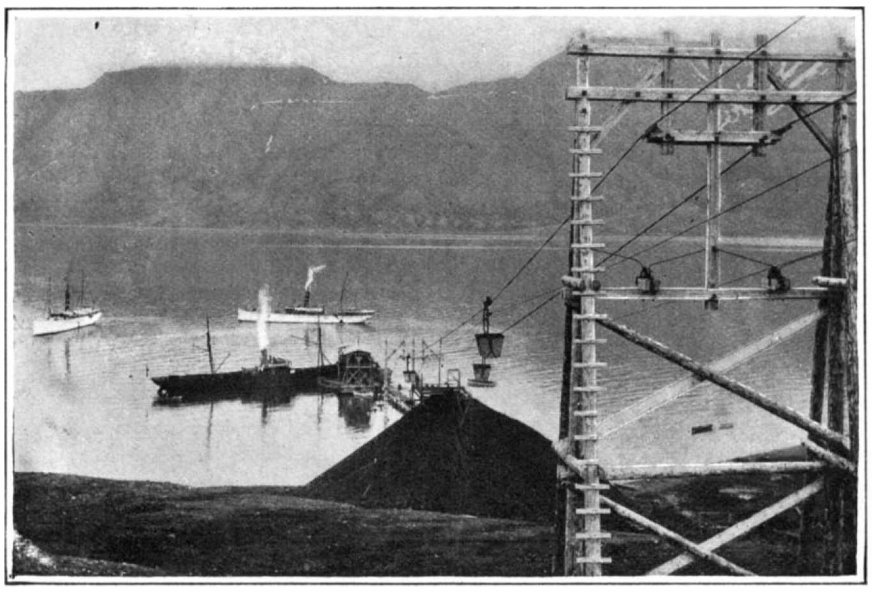
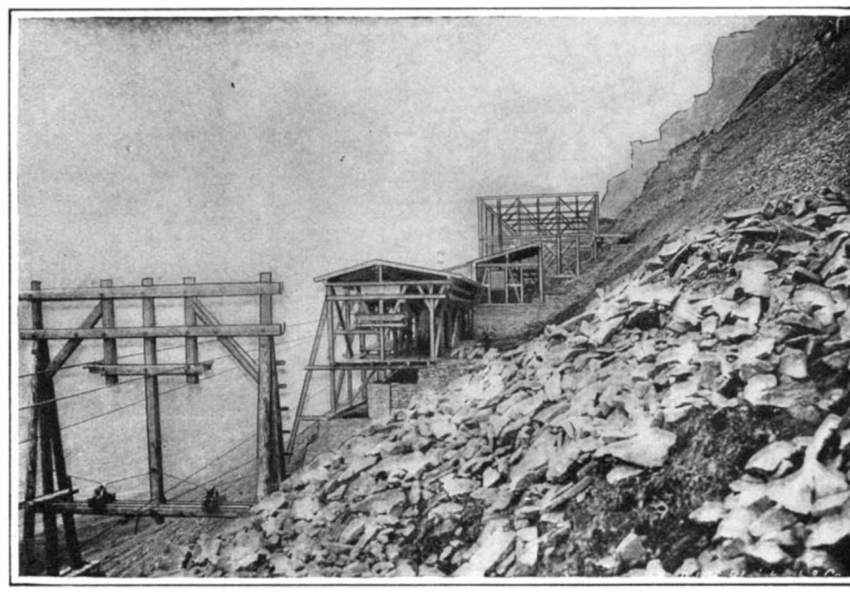


Photo. by Levick

**Scene at headquarters during volunteer militia maneuvers.**



Steamer taking coal and two others waiting their turn.



The upper loading station.

# Heat from Our Lady of the Snow

## Coal-Mining in the Arctic Circle

By H. J. Shepstone

THE successful mining of coal in Spitzbergen, and the erection there of an ingenious cableway for transporting it to ships, calls attention to the development of this strange archipelago in the Arctic circle. It is just over a year ago that this famous group of islands, lying some 400 miles north of Norway, was declared neutral territory. This was the result of a conference between the governments of Russia, Sweden, and Norway to settle the question which was frequently asked as to who really owned Spitzbergen. The country is now open to all nations and is governed by a joint board consisting of one representative of each of the three powers named. It had long been known, of course, that coal existed in Spitzbergen, just as it does in Greenland and Alaska. It was generally believed, however, that it was too poor and the seams insufficiently thick to prove of any commercial value.

So far as Spitzbergen is concerned, opinions on the value of the coal lying there have greatly changed. In the summer of 1911 some twenty-five large cargoes of coal were mined and exported, the output in the following year being increased to over one hundred cargoes, while to-day between 500 and 600 shiploads of coal are carried away from its inhospitable shores during the summer months.

The coal found in Spitzbergen is of good quality. It contains only 2 per cent of red ash, no slag at all, and is free from slate. The prices obtainable are good, and amount to $4 per ton in Advent Bay for direct sale to the whalers; $5 at Trondhjem, Norway; while English coal on the north coast—in Hammerfest, for example, the most northerly town in Europe—costs about $7.50 per ton.

The coal often comes to the surface, and is worked by a Boston company, which has secured in Advent Bay a coal-field three to four miles long. The company has undertaken further expeditions with its steamers, and has also found a coal-bed in Saxon Bay at a height of 400 feet above sea level, which, however, is not sufficiently productive to pay for its working. At Cape Bojan very good coal is also to be found, though here, on account of the heavy surf, the working is fraught with considerable difficulties. On the other hand, the company has taken over a coal mine in the vicinity of the fish-oil boiling house in Green Harbor, 200 feet above sea level, which yields a very good and firm coal, and here there are good landing facilities.

The working of the coal, which, up to the present, has been carried on only in Advent Bay, is advanced by gallery-driving. The galleries are driven almost horizontally into the mountains, the coal being cut, and only props left as supports. Walling is not necessary, as a temperature of 42 deg. Fahr. prevails in the galleries, so that the mountain remains quite firm. The working of the mine is, according to the time of the year, divided up into two parts—the summer and the winter campaigns. For the summer campaign, which lasts from the beginning of June till the middle of September, 200 men come from Norway to Advent Bay by the company's steamer "Munroe." During the winter only 100 men remain there. They work 9¾ hours a day and live, from eight to twenty men, in workmen's houses, which consist of board partitions fourfold thick with cardboard between.

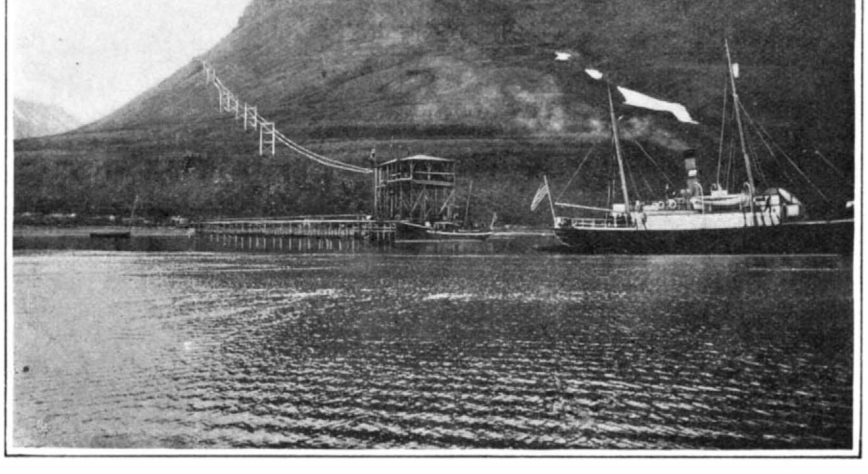
The coal is carried from the galleries at a height of about 650 feet above the level of the sea, and immediately tipped, near to the gallery mouth, over a chute into a hopper which extends close up to the coaling station of the ropeway. The wire ropeway then carries the coal direct into the ships. The ropeway possesses a rather heavy gradient from the loading station, located on the mountain above, to the unloading station erected in the sea. Its horizontal station consists of a hopper building and a suspension railway circuit on which the ropeway cars are loaded. They are then pushed out of the station by hand and couple themselves automatically to the traction rope, which is in constant motion. The ropeway runs over sixteen wooden supports and has a free span of 800 feet from the last support to the unloading station in the sea. The depth of water in front of the unloading station is 36 feet, so that large ocean steamers are enabled to come alongside.

Special difficulties hindered the erection of the ropeway, as all building material, including logs from 55 to 65 feet long, had to be brought in by ship. The driving sheaves, and the break regulator weighing about two tons, had to be lifted by means of winches and steel ropes, the boulders on the mountainside, which were continually crumbling away, presenting very considerable difficulties. The piling of the supports and the laying of the foundations of the structural parts were much impeded by the permanently frozen ground. Only under the direct rays of the sun does the ground thaw, and then only to a depth of 8 inches. All holes, therefore, had to be blasted with dynamite. The pile-driver was then set on the ice and the supports driven into the holes. At the commencement of the erection work the company's steamer was not successful in getting into Advent Bay, because Spitzbergen was surrounded by pack-ice. It was, therefore, necessary to drag all the building material over the ice on sledges.

Spitzbergen has now undertaken the supplying of coal to whalers cruising in the polar sea and to the north of Norway, thus competing with the English coal previously unchallenged there. This state of affairs has been thoroughly grasped, and an English company has taken in hand the mining of a Spitzbergen coal-bed.

### The Current Supplement

THE current SUPPLEMENT of the SCIENTIFIC AMERICAN, No. 2041, for February 13th, is unusually varied in contents and interest. Meroë, the Royal City of Ethiopia, tells of discoveries that throw light on astronomy as practised centuries ago. Waste in Hiring and Discharging Employees raises and discusses an economic question of the greatest importance to every employer of men and to every student of economic subjects. Making Safe Steel Rails describes a radical method of treating material to eliminate certain causes of frequent failures in railway rails. New Faunal Conditions in the Canal Zone gives some details of an expedition that investigated the results of the creation of the Gatun Lake. Other articles treat of protection of ships against torpedoes; a review of developments in wireless telegraphy; the inventions of Edward Weston; Twilight Sleep; a war-time fertilizer; the Treatment of Blast Furnace Gas is continued, and there are other matters of value to all who like to keep themselves informed on the doings of the scientific world.



The aerial cableway as viewed from the water.

The cableway running inland.

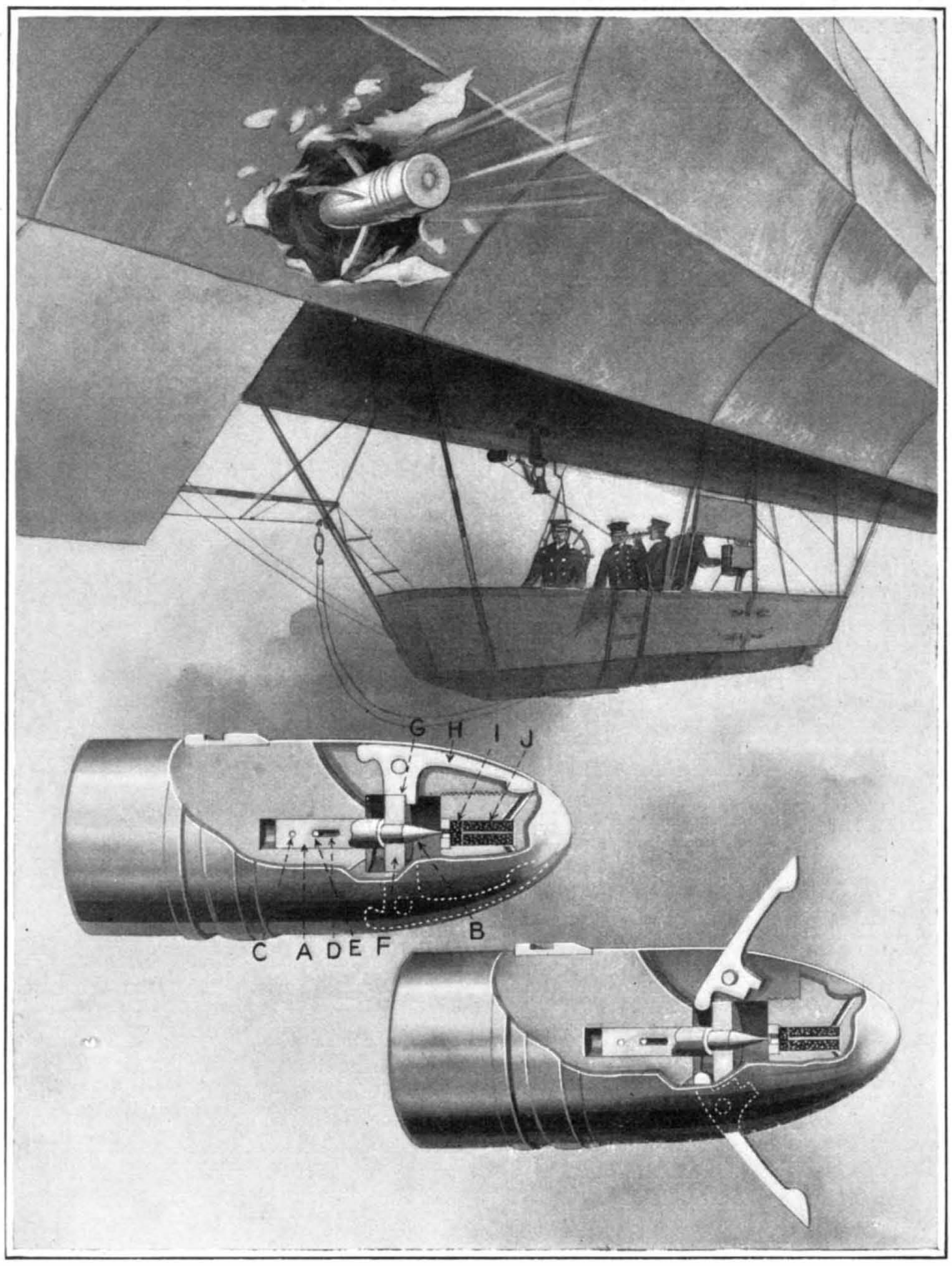
# Inventions New and Interesting

## Simple Patent Law: Patent Office News; Notes on Trademarks

### Shells for Destroying Airships

THE recent raids on the English and French coast towns by the Zeppelin airships have given fresh point to the discussions of methods of defense against aerial cruisers of this sort, and how they can best be destroyed. It is evident to all who have considered the subject with a knowledge of the construction and character of these craft that a shot, even of large size, penetrating the huge gas reservoirs is not likely to have any serious effect, for the gas would be liberated so slowly from any ordinary sized hole that the vessel might not be seriously inconvenienced, and even if eventually compelled to land on account of the injury, might easily keep the air until it reached friendly territory. To be effective, therefore, a projectile to be used against airships must be capable of producing an opening in the envelop of very considerable size.

It is interesting in this connection to note that the subject has not been overlooked by those who make a study of military subjects, as is indicated by a patent for a special projectile that was issued recently to the firm of Sir W. G. Armstrong, Whitworth & Co., the great builders of warships and guns. The invention is illustrated in the accompanying drawings. It will be seen that this projectile carries in longitudinal slots cut in its head a series of pivoted blades *H*, which ordinarily are held in place within the shell by a disk *F* on the firing pin *A*, which engages a notch *G* in an arm of each blade. The firing pin *A* is normally held in place by a light shearing wire *C;* but when the projectile is fired from a gun the shock of the discharge, acting through the inertia of the firing pin *A*, causes the pin to be thrown backward, shearing the wire *C*, and releasing the blades *H*, which then open out as the result of air pressure or centrifugal force, and the projectile in this condition is capable of tearing an opening in the envelop of the airship several times the diameter of the shot itself, and the whirling motion of the projectile is expected to add to this result. But mere penetration of the envelop of the gas compartment is not the only result expected of this new projectile, for it is constructed as an explosive shell containing a charge of high explosive, as shown at *J*. After the firing pin *A* has severed the restraining wire *C*, its movement is still limited by a second shearing wire *E*, that passes through a slot *D* in the pin, and no ordinary movement of the shell will result in its discharge. When, however, the extended blades *H* strike anything that causes resistance they are forced backward, and their extended rear ends acting on the disk *F* will force the firing pin *A* forward, shearing the second restraining wire *E*, and driving the needle point *B* into contact with the detonator *I*, which explodes the shell. It will be seen that this explosion is calculated to take place within the body of the airship, with the result of disrupting the gas containers, and probably firing the gas as well, thus effectively destroying the craft, or at least compelling instant descent. Whether these shells have been brought into service or not has not been announced.

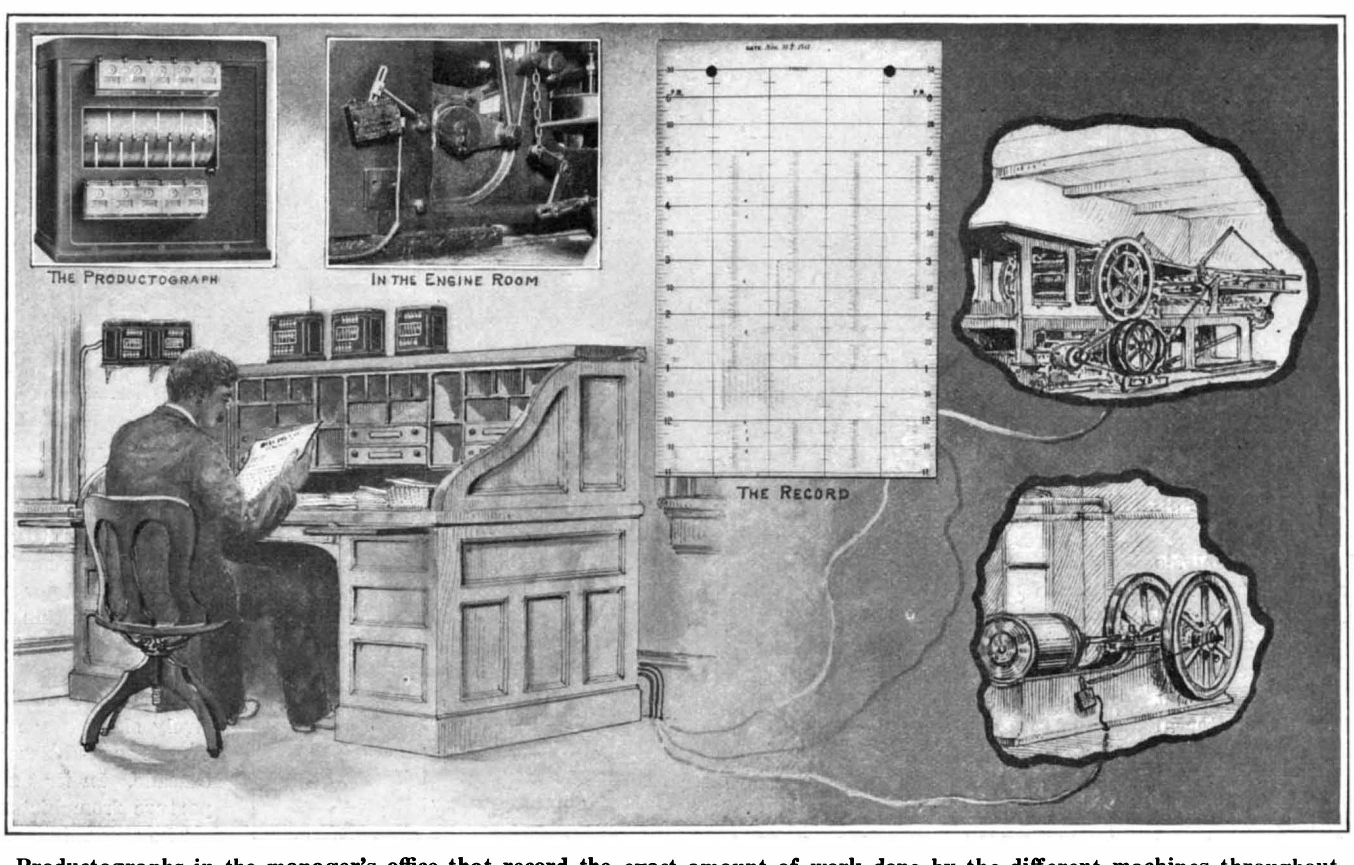



**A new explosive projectile that tears open the gas bag of an airship.**

### Watching Distant Machines from a Desk

**By Herbert T. Wade**

IN manufacturing and all other mechanical operations where an effort is made to secure increased efficiency, or the maximum results from a given plant or equipment, with a fixed or minimum expenditure of energy, power or personal attention, it is naturally of fundamental importance to secure an accurate knowledge of the performance of a given machine or individual. In short, efficiency studies may be divided roughly into those where the personal side, dealing with the laborer or operative, is paramount, and those where the output and performance of a given machine are investigated. Efficiency, in other words, is simply a ratio, and the higher the percentage of actual output or performance, as compared with possible performance or output, the greater the return to the wage payer or owner. The mechanical problem involved in studying the performance of a machine in its essence is of the simplest; a shaft makes so many revolutions, so many yards of cloth are woven by a loom, so many barrels of flour are packed at a roller mill, so much current passes through a recording wattmeter, an elevator travels so many miles on its daily travels, and a thousand and one other operations. All these items must be considered in relation to some unit of time as a rate of production or measure of efficiency, and must be indicated plainly to be digested by a responsible head of the plant. If one of ten machines is idle, the output is correspondingly decreased by 10 per cent for the length of time it is inoperative. If fewer yards of cloth are being wound off the loom than its rated production, there is a corresponding loss to the mill. Accordingly, any device that assembles for the information of a central head an actual record of the performance of his machinery is invaluable, not only as an indication of what is happening at the instant, but as supplying a basis of comparative cost accounting. The efficiency studies should not stop at mere indication, study, or suggestion, but be so presented as actually to secure increased efficiency, either by indicating at once the necessary repair or adjustment of machines, the addition of new and superior equipment, or the elimination of lost motion at one point or another along the line. To secure this elementary datum, and place it at the disposal of a cen-




**Productographs in the manager's office that record the exact amount of work done by the different machines throughout the factory.**

tral head, there has been evolved recently an instrument known as the productograph, which in connection with modern methods of economy and efficiency studies brings to a common center and there records the necessary data as to the mechanical operation of a plant, whether the various elements or machines of the same are separated by considerable distance or not. The productograph consists essentially of a special form of switch by which an electric current is opened and closed, corresponding with the operation of a machine or mechanism. Such a device in essence might be of the simplest character, but in this new system the switch is arranged so that for every motion to and fro of its lever a ratchet is advanced by one tooth, while a second wheel carrying a cam mounted on the same axle does not operate a lever connected with a dash pot and electric circuit breaking mechanism, until the first wheel has been advanced by ten teeth, corresponding of course to ten movements; then a circuit is completed and the current, which is supplied at low voltage from a special motor generator set, is sent over a conductor to the indicating mechanism. The pneumatic cylinder of the switch prevents absolutely any short circuit. The indicating mechanism consists of a series of electromagnets, one magnet for each circuit, each, however, supplied with two armatures, one of which actuates an indicator having numbers on the faces of its dials or revolving wheels by which the number of revolutions or other movements of the switch are shown, while the other armature and mechanism is connected with a German silver pin or needle point, which on the closing of the circuit makes a line on a strip of lead paper driven by clockwork, so that a graphic record appears in the spaces divided to represent hours and minutes. The mechanism is so arranged that each tenth stroke is longer through the increased motion of the armature, and as each stroke corresponds with ten movements of the original switch, the long marks on the record indicate 100 movements of the machine.

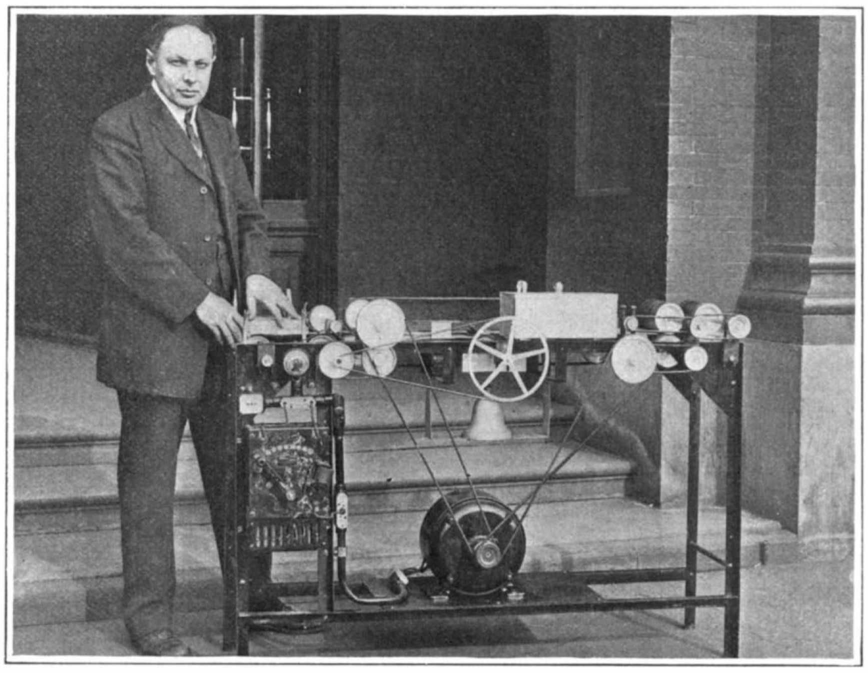
As actually installed in many plants a number of these recording devices are combined; as many as twenty have been arranged together, and while they are all similar in their general action, yet the information that they supply may cover a wide range of activities. Thus in a large printing plant one switch may be attached to a linotype machine and the number of lines set by the operator be registered automatically on the dial. Another machine may be connected to a press and give the number of sheets printed, while another in the bindery may indicate the number of books bound. Yet before the manager's eye the complete activity of the plant is apparent.

Again in other establishments the number of bottles filled, the number of defective bottles, the number of cases, the amount of liquid passing into a tank; the amount of coal weighed into the coal elevator, the number of movements of a dredge bucket; and, in fact, all desired information immediately and quantitatively is recorded.

In all efficiency studies knowledge of conditions and performance is the first consideration, and with this accumulated by a device which indicates also the production, the efficiency engineer or superintendent can proceed to better his output.

Realizing as he can at a glance, that machine No. 10 was idle for two hours, it is possible to investigate the reason and to provide against such shortcomings in the future, whether they are the result of personal or mechanical causes. If another machine supplies but a fraction of the output of its neighbor it does not take very long for the efficiency engineer to determine the fact and to change conditions.

The records are available for analysis either by the managers of the plant or by trained outside experts, and the logical development would seem to be a central office of efficiency where a superintendent would analyze not once a year, but once an hour or at even a less interval what is happening within the walls of his factory, or, in fact, within several allied establishments. So far the system has been made with twenty indicators, but there seems to be no limit as to its application either in extent or in range. The current, which amounts to but one half ampere per needle, may be derived from any lighting circuit, either alternating or direct, preferably through a motor-generator, and the low voltage of the operating circuit does not present any difficulty in the way of wiring to increase the insurance hazard or to involve undue expense either for installation or maintenance. While all efficiency studies and work are fundamentally psychological, yet mechanical adjuncts play an important part, and of these the productograph is typical of what may be used in order to secure and properly co-ordinate the knowledge on which mechanical efficiency must depend.



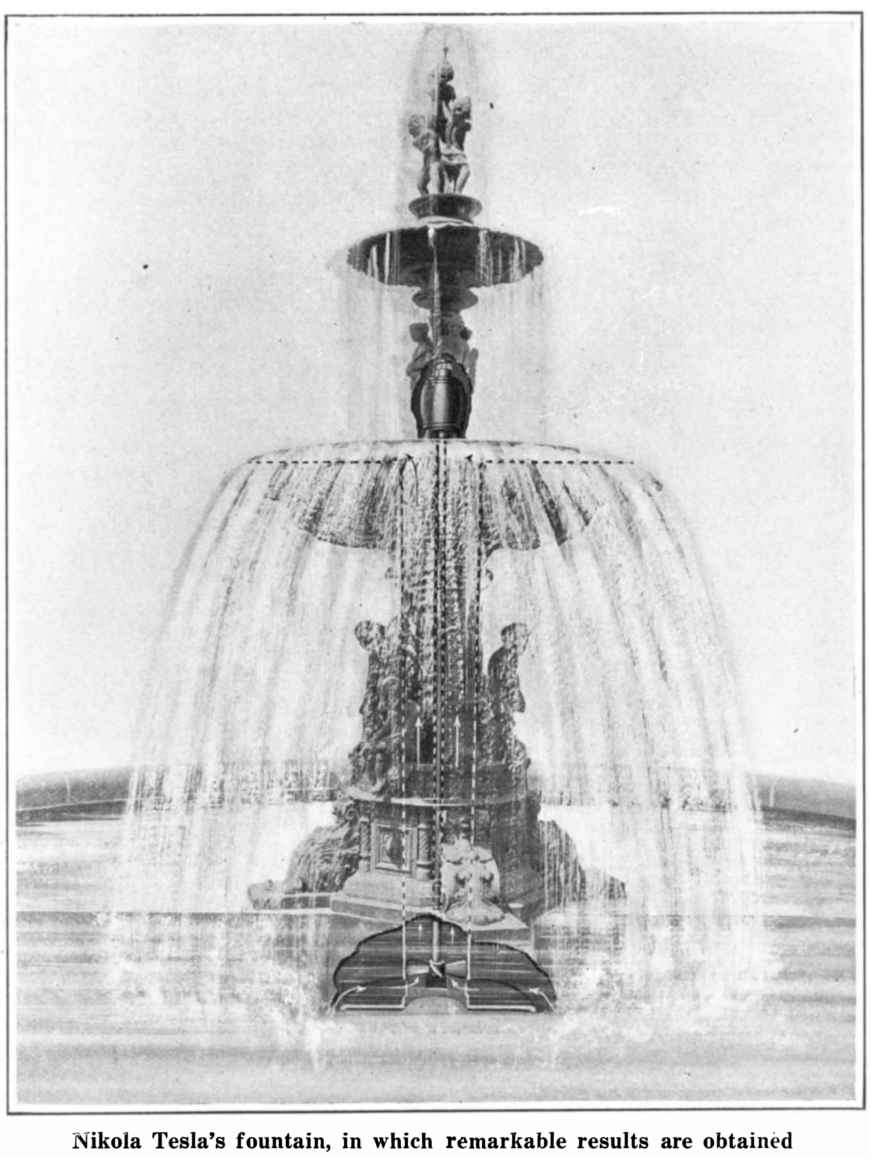
Machine that seals one thousand envelops per minute.

## The Envelop Sealer of the Pension Office

As may well be imagined, the envelop output of the Disbursement Office of the United States Pension Office, at Washington, D. C., is very large indeed, and there has been a demand for a machine of large capacity for sealing envelops. Realizing this need an assistant messenger of the office, Mr. Fred W. Carrington, undertook to build a machine of the type required. In this he was successful. The capacity of the machine so far as has been tested is from seven hundred to a thousand or more envelops per minute.

The envelops can be placed in a bunch or bundle upon the feed belt, and will automatically feed themselves into the machine and pass out at the delivery end properly sealed.

At present the receptacle for the sealed and delivered envelops is not in the most satisfactory form, and will constitute the subject of another invention. A patent on this machine was granted to Mr. Carrington on December 15th, 1914 (No. 1,120,688), and he has dedicated it to the public. As a reward for his ingenuity and service to the Government, President Wilson has appointed Mr. Carrington to the clerical grade without examination under the Civil Service Bureau. The features of Mr. Carrington's machine, which are regarded as of considerable importance, are the means of adapting it for envelops of different sizes, and particularly a feed belt of corrugated rubber, which is laid off in sections, the belt being operated rapidly to feed the envelops one at a time into the machine. The moistening means includes a pan of water heated by an alcohol lamp, it having been found that the machine operates so rapidly that cold water will not soften the glue of the envelops in the short space of time in which the envelop passes through the machine.



Nikola Tesla's fountain, in which remarkable results are obtained with little water.

## Nikola Tesla's Fountain

It is a curious fact that, old as fountains are, they have remained essentially unchanged in principle for centuries. Artists have lavished all their skill upon them to make them beautiful, but engineers have neglected them. To be sure independent pumps of small volumetric capacity have been used to create artificial waterfalls and to use the same water over and over again. But this principle is old and the spectacle offered to the eye not a great improvement over the fountains of olden times.

Two types of fountain have chiefly prevailed—the cascade in which a moderate volume of water falls in thin but brilliant sheets over multiplied obstructions—steps, basins, rocks, etc.—always in a framework of architecture with abundant obstructive accessories; and the isolated or central fountain, in which one or many jets, spouted upward, fall into the highest of a series of superposed bowls of marble or bronze and then into a larger one below and so on into a broad basin at the ground level. Although every effort was made to save water and to obtain the maximum effect, still we find that in most European cities, fountains are allowed to play only on certain days of the week, and then only for a few hours. It may be safely said that not since the days of the Italian Renaissance has any really startling improvement been made in the hydraulics of fountains.

Into this neglected field, Mr. Nikola Tesla, the distinguished engineer, has entered, and as might be expected of him, with very strikng results. He has recently patented a fountain of entirely new principle, and one moreover in which imposing effects are obtained with very simple apparatus and with a very small volume of water. The accompanying illustration pictures the very simplest form of fountain which can be constructed, according to Mr. Tesla's ideas. A shaft runs vertically through the central column of the fountain, carrying at its lower end a propeller, and at its upper end an electric motor, suitably braced. In our illustration we show this propeller shaft contained in a tube, the bottom of which is provided with inlets for the water in the main bowl. As the propeller is made to revolve the water is sucked in by the propeller blades through the inlets, and is urged upward in the direction of the arrows. It fills the upper bowl and then overflows in a miniature waterflow of impressive size.

As the circulation is extremely rapid, the total quantity of water required is comparatively small. About one tenth of that delivered per minute will be generally sufficient. In this fountain then, we find a great mass of water propelled by the use of only such power as is required to lift it from its normal level through a relatively short space to that from which it overflows and descends as a waterfall or cascade. In that sense it is a radical departure from historic fountains.

The apparatus not only makes the breeding of insects impossible, but is in a sense a very efficient trap.

## RECENTLY PATENTED INVENTIONS

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

### Electrical Devices.

TELEPHONE ATTACHMENT.—J. WHITAKER, 4735 Leiper St., Frankford, Philadelphia, Pa. This invention has reference to a means for hanging up the receiver of the telephone when not in use. It is an object of the improvement to provide a means whereby when the receiver is released by the user, the switch arm will be automatically lowered.

### Of General Interest.

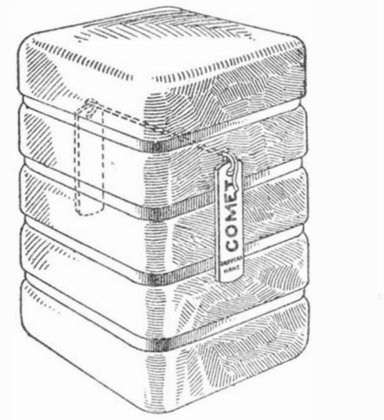
ENVELOP.—P. A. HOFFMAN, Hastings, Minn. This invention has reference to improvements in envelops, and has for an object the provision of an improved structure which will act properly as a closure or document wrapper, while eliminating tapes, rubbers, and other similar fastening means.

INDICATOR.—J. FRAME, Searsport, Maine. The invention relates particularly to indicators for vessels, and has for an object the provision of a structure which will automatically and correctly indicate the amount of "pitching" of a vessel or the amount of tossing of a vessel.

CAN NOZZLE PLUG SEAL.—F. WETTERBERG, care of N. J. Wood Fiber Co., Perth Amboy, N. J. The invention has reference more particularly to plugs for varnish cans, having means which seal the plug in the nozzle of the can. An object is to provide an easily removable plug which has means for sealing the nozzle of the can.

FLOTATION BELT FOR VESSELS.—C. M. BUZUK, 217 Green St., Brooklyn, N. Y., N. Y. The invention provides auxiliary members adapted for disposition in service relation to be inflated; provides flotation displacement at the outside of the hull of a vessel; provides means for protecting flotation members in service relation from drainage due to abrasion or shock; provides means for rapidly and readily covering the flotation members; provides floating means with armor to prevent injury thereto; and provides means whereby the flotation capacity of a vessel may be augmented at will.

FASTENING FOR SHIPPING TAGS.—E. L. WILSON and J. J. REILLY, care of the former, 210 Sip Ave., Jersey City, N. J. This device consists of extending wires or rods through the bale while the latter is being compressed, so that the ends of these wires will project

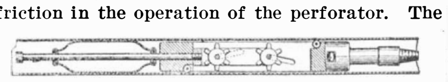



FASTENING FOR SHIPPING TAGS.

from the faces of the bale in single or in pairs, for the novel attachment of tags which are preferably of such indestructible material as tin, and which are marked to identify the goods. The tags are mounted on both sides of the bale so that the goods can be more readily identified, and it is not necessary to provide any burlap.

### Hardware and Tools.

WELL PIPE PERFORATOR.—A. C. GRAHAM, 311 Cherokee Ave., Barttesville, Okla. The invention provides a tool adapted for operation simultaneously at opposite sides of the pipe or casing of a well to produce perforations therein; provides a simplified construction of perforator; and provides for the reduction of friction in the operation of the perforator. The

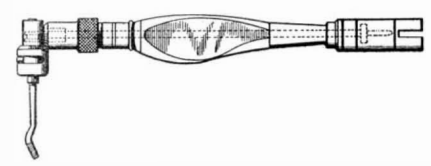


WELL PIPE PERFORATOR.

engraving shows a vertical section taken on the median line of a perforator, the parts being represented in the out-of-service position they have when being fed into a well.

SASH LOCK.—C. E. JANES, Lynbrook, N. Y. The invention comprises separate sash-locking means separately attachable to upper and lower sashes, and each having a bolt adapted to be projected to engage the window frame, together with actuating means for the bolt, said means including a coupling bar adapted to couple the two sash-locking means when the same are brought into alignment, whereby the bar will form a connection between the two sashes, as a locking means therefor, in addition to the separate locking of the separate sashes to the frame by means of the bolts.

DENTAL TOOL.—F. E. PERKINS, Largo dó Carioca 9, Rio de Janeiro, Brazil. The tool is designed more particularly for the treatment of pyorrhea. It includes a handle and a longitudinally vibratory shaft extending at an angle



DENTAL TOOL.

with respect to the handle and to which the operating implement is attachable, together with means whereby said implement may be adjusted or revolved around a tooth during its vibratory movement by the hand of the operator.

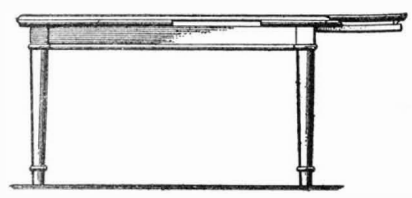
### Heating and Lighting.

LAMP CLEANER.—W. D. BOWIE, Bowie, Colo. The object in view is to provide an easily operated cleaner for the gas outlet pipe in miners' carbid lamps. Another is to provide a device easily applied and removed, and also easily and quickly operated at any time for cleaning the gas outlet tube in lamps using calcium carbid.

### Household Utilities.

EGG BASKET.—A. E. TRENTOWSKY, St. John, New Brunswick, Canada. An object in view of this invention is to provide an improved basket structure for holding eggs or other articles to be cooked, in connection with the timing device, which may be caused to indicate any desired time so that the eggs or other articles may be properly cooked.

EXTENSION TABLE.—V. F. NEUMANN, New York, N. Y. The table embodies a plurality of sections or leaves which, when not in use, can be pushed in out of the way under the table top. An equal number of leaves are used at opposite ends of the table so that it



EXTENSION TABLE.

can be lengthened at one or both ends. When the length of the table is increased by means of the extension, one or more of the extensions can be used, so that the top can be lengthened at either or both ends to a greater or less degree.

### Machines and Mechanical Devices.

TURNTABLE FOR STONEWORKING MACHINES.—F. E. LANG, 41 Hill St., Barre, Vt. This adjustable turntable is designed to economize time and labor in handling stone to be finished under pneumatic surfacing, polishing machines, or under any similar machine that requires an adjustable table for the leveling and squaring of the stone, and the setting of the work at any angle.

SPACING BLOCK.—S. F. KRUPP, Box 1697, Atlanta, Ga. The inventor provides a block of minimum weight, maximum strength, and permits of being placed easily in position on the saw shaft or arbor to accurately space the adjacent saws the desired distance apart and to hold the saws parallel to the plane of rotation to the saw cylinder.

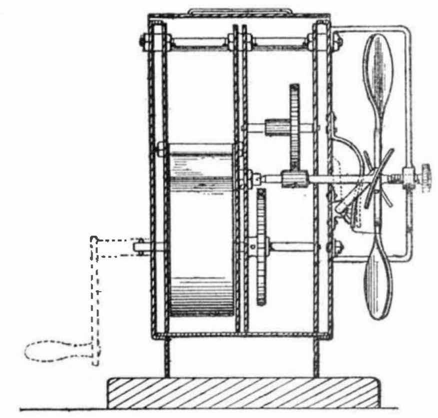
TORSION METER.—T. B. THOMPSON, 2506 Clifbourne Place, Washington, D. C. The invention relates to devices for measuring the torsion of shafts, especially those shafts which are used in marine engines of the turbine type. It provides a device by means of which the amount of torsion developed in a given length of shaft of certain size may be quickly and accurately determined.

ROTARY DRILL BIT FOR OIL WELLS.—W. M. KECK, Coalinga, Cal. The invention has particular reference to means for boring rapidly through various characters of earth or rock. It provides a drill bit, preferably of the fish tail form, adapted to operate rapidly and without clogging through soft, sticky, or shaly rock.

DROP DOWN SMALL ARM.—W. BAKER, 87 Snow Hill, Birmingham, England. The purpose here is to provide an automatic cocking and firing mechanism for drop down guns of the type in which the cocking and hammer levers are mounted on a common pivot. The invention comprises the pivoting on the cocking lever of a pin which passes through or alongside the hammer lever, and the mounting on the said pin of a spiral firing spring.

PUMP.—H. WELLINGTON, deceased. Address Mrs. Louise F. Wellington, 2068 Fifth Ave., New York, N. Y. This invention is more especially designed for use in wells, mines, and other places from which water or other liquid is to be raised to a desired height, is arranged to insure raising of water or other liquid at a minimum expenditure of power, prevents binding of the revolving lifting devices, reduces destructive vibrations and permits removal of the lifting devices for repairs, etc., without disturbing the pump cylinders.

MACHINE BRAKE.—J. C. MCGEE, Grenada, Miss. The object here is to provide a brake especially adapted for use with fans for cooling buildings or for producing currents of air wherever desired, and especially fans driven



MACHINE BRAKE.

by spring motors, wherein the brake is arranged to engage the fan directly, for holding the fan against movement during the winding of the motor, or at any other time, the said mechanism being releasable.

PHOTOGRAPHIC PRINTING MACHINE.—B. O. FJORKENSTAD, Fingal, S. D. The machine is designed especially for printing on developing papers, and the primary object of the invention is to provide for printing on developing paper where speed, accuracy and uniformity of results are desired, whether used with natural or artificial light.

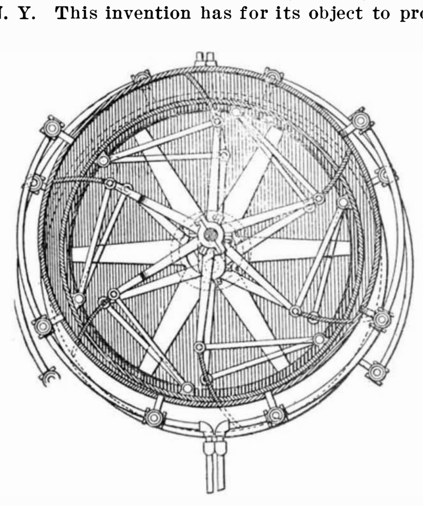
MINE CAR STOP.—J. T. PERO, 1801 Monroe Ave., Scranton, Pa. This invention provides means for arresting the downward progress of an elevator in a mine shaft, the operation of which serves to release, for delivery to the elevator, a waiting car; and provides means for preventing the overrunning of cars into the shaft when the elevator is not in position to receive said cars.

### Prime Movers and Their Accessories.

FOUR CYCLE ENGINE.—C. W. SNYDER, 1861 W. 12th St., Los Angeles, Cal. The purpose here is to secure both the scavenging and the cooling of the cylinder, by causing air to pass through the cylinder when the piston is at or adjacent the end of the power stroke, so that when the piston completes its scavenging stroke, the gases remaining in the cylinder will be largely air instead of burned gases.

INTERNAL COMBUSTION ENGINE AND METHOD OF SCAVENGING THE SAME.—C. W. SNYDER, 1861 W. 12th St., Los Angeles, Cal. It is the object of this invention to utilize the vacuum in inducting air from the outside atmosphere into the engine cylinder to scavenge the same prior to the admission of the fuel charge. Air admitted in this manner prevents the return movement of exhaust gas through the exhaust port into the cylinder, it permits the exhaust gas to continue moving out the exhaust conduit, and thus to replace by air a portion of the exhaust gas normally remaining in the cylinder at this time.

ROTARY ENGINE.—S. D. SIMMONS, care of Henry Amling, 4228 Park Ave., Bronx, N. Y., N. Y. This invention has for its object to pro-



ROTARY ENGINE.

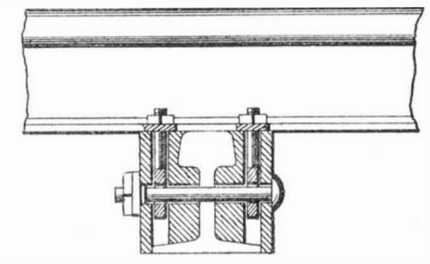
vide a rotary engine having blades extending through slots in a rotatable drum disposed in a casing and eccentric with a shaft, a portion of the casing being eccentric with an adjacent portion of the casing, and the shaft being provided with a crank disposed in the said adjacent portion of the casing.

### Railways and Their Accessories.

SHIPPING UNIT.—J. W. TERRY, 32 Augusta St., San Antonio, Tex. This invention refers to a shipping unit or carrier for the transportation of merchandise as freight, express, or baggage, the said unit comprising generally a wheeled structure of predetermined size, a given number of which may be contained in an ordinary box car and transported bodily, to the end that labor and time be minimized in the loading, transportation, and unloading of small consignments.

RAILWAY TRACK.—T. G. MCNEILL, Ludlow, Cal. This improvement relates to a means for holding track rails in a manner to prevent creeping of the track, or of either rail thereof, the rail-holding means, moreover, being formed and positioned to prevent destruction of the same by expansion or contraction of the rails.

RAILROAD TIE.—E. SAMUELSON, St. Peter, Minn. One of the principal objects of the inventor is to provide means adapted to be carried by a cross-tie, for securing the track rails in place on the tie. He provides rail fastening means adapted for use with lengths of worn out rails whereby the latter may be utilized as cross ties. He also provides in combination with a rail length means for engaging the base flanges of the track rail, and means for ad-

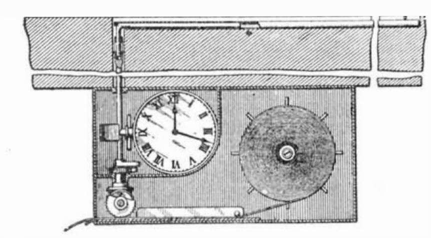


RAILROAD TIE.

justing the rail engaging means both longitudinally and vertically whereby to accommodate rails of various dimensions.

### Pertaining to Recreation.

CONTROLLING DEVICE FOR BILLIARD TABLES AND THE LIKE.—L. BERNARD, 73 Third Ave., Manhattan, N. Y., N. Y. This inventor provides a device for billiard tables, pool tables, and similar game apparatus, and ar-



CONTROLLING DEVICE FOR BILLIARD TABLES.

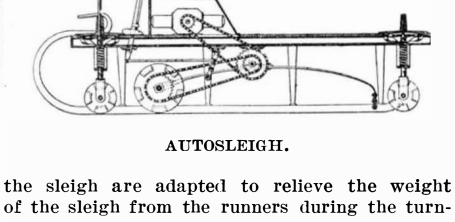
ranged to automatically register the time the apparatus is used during the day or other given period, and also to register the number of games played during such period.

### Pertaining to Vehicles.

REAR END SIGNAL FOR VEHICLES.—G. J. WOHLTMANN, 241 61st St., Brooklyn, N. Y., N. Y. The invention provides a signal, the operation of which is simple and concordant with the movement of the hand of the driver or traffic manager, and provides a signal arranged to show, under all conditions, the rear-end or danger light.

PIVOTAL TURNING MEANS FOR AUTOMOBILES.—A. I. MCGLOUGHLIN, care of E. Flagg, 109 Broad St., New York, N. Y. This invention relates generally to a pivotal turning means for automobiles and the like, characterized by a structure permitting the vehicle to turn about a point which is substantially at the middle point of the rear axle.

AUTOSLEIGH.—L. TOWNSEND, 416 Chestnut St., Evansville, Ind. The object of the invention is to provide a strong and inexpensive sleigh which is easily controllable, and on which the traction wheels are so arranged as to prevent sliding sidewise. The means for guiding



AUTOSLEIGH.

the sleigh are adapted to relieve the weight of the sleigh from the runners during the turning of the sleigh. The sleigh can be quickly stopped, the means for this becoming operable when the traction wheel is rendered inoperative.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

WE wish to call attention to the fact that we are in a position to render competent services in every branch of patent or trade-mark work. Our staff is composed of mechanical, electrical and chemical experts, thoroughly trained to prepare and prosecute all patent applications, irrespective of the complex nature of the subject matter involved, or of the specialized, technical, or scientific knowledge required therefor.

We also have associates throughout the world, who assist in the prosecution of patent and trade-mark applications filed in all countries foreign to the United States.

MUNN & Co.,
*Patent Solicitors,*
361 Broadway
New York, N. Y.

Branch Office:
625 F Street, N. W.,
Washington, D. C.

INQUIRIES

*Inquiry No. 9420.* Wanted the name of a concern who can make a glass jar.

*Inquiry No. 9421.* Wanted to find a manufacturer who can turn out scissors in thousand lots. Special design. Full particulars on application.

*Inquiry No. 9422.* Wanted the name and address of a manufacturer of a machine which can crack Japanese walnuts whole.

*Inquiry No. 9423.* Wanted the name and address of a concern that manufactures a product which is light in weight also pliable to the tensity of spring steel in flexibility. The material is wanted in strips varying from ¼ to ¾ of an inch in width and from 4 to 8 inches long and 3-32 to 1-16 of an inch in thickness. Vulcanized rubber would answer the purpose provided it could be made to bend.

*Inquiry No. 9424.* Wanted the name and address of a manufacturer who can supply paper twine and what is known as cardboard strip.

*Inquiry No. 9425.* Wanted the name and address of a manufacturer of supplies for model aeroplane and boat builders.



## Kammerlingh Onnes

*(Concluded from page 151.)*

the laboratory has been a generous and open one. Investigators of the world are welcome. They are received cordially, the director discusses with them their ideas, he lays out a course of investigation, then the apparatus is prepared by the laboratory, and the foreign specialist and Onnes together work out the results. This planning lays at the feet of the investigators of the world the best means for their experiments, it conserves effort and equipment, and it secures to the Cryogenic Laboratory a share in whatever may be done, and places the publication of the descriptive papers in the proceedings of Dutch societies.

Denmark preserves the name and fame of the dead Thorwaldsen in a collection of his statues, and he who would study the originals by the great master must go to Copenhagen to find them. Leyden is erecting a similar memorial to Onnes while he lives by making itself the focus of cryogenic research, and he who would know of the story will learn it from Dutch publications—in English if he will—and the important work is practically retained in Dutch hands.

It is only natural, therefore, that Onnes should have had as co-workers with him in his laboratory an important number of the world's strongest specialists. He has experimented together with Madame Curie in radiometry at the world's lowest attainable cold, and with another woman specialist, Miss T. C. Jolles, in the intricacies of the van der Waals problems. With the two Becquerels he has discussed the phosphorescence of uranyl and other salts, and with Jean Becquerel alone the behavior of certain rare earths. With Zakrewski as early as 1894 there were undertaken some of the van der Waals researches and the determination of the co-existence of both vapor and liquid states of gases at very low temperatures. With Lenard and Pauli, Onnes investigated other uncommon minerals, and with Weiss some deep questions of magnetism, which resulted in the "magneton" hypothesis. Methods of measuring under the new order of things were undertaken with C. Braak in 1909 and with Clay; then with Crommelin of his own university various technical data were secured of argon, oxygen, and other gases, four or five papers being needed to present the results. With two compatriots further work was undertaken in 1912, de Haas making some measurements on hydrogen and Oosterhuis a set of observations on paramagnetism. Perrier worked at Leyden in magnetism, resulting in four papers; Dr. Hyndman tested various forms of instruments; Bondin was associated with the laboratory in work on hydrogen. Kesson was another foreigner, and very recently Bengt Beckman has taken up the Hall phenomenon, which considers the effect on a current when the conductor is placed in the field of a magnet. And these items enumerated are but a skimming of the collaborative work.

It is to be remembered that during all this time dozens of researches were conducted by Onnes with no other help than the laboratory force. These cover every phase of the condition of gas at low temperatures, viscosity, volume, vaporization, temperature and tensions and of many solids, and include numbers of collateral investigations of conductivity, condition and change, with full consideration for general hypotheses and special suggestions. The reports of the investigations are voluminous and somewhat scattered, although kept pretty well within the proceedings of the Amsterdam Academy and other scientific societies of Holland. At the same time, for the convenience of the scientific world, Onnes has brought together abstracts of the principal papers in a set of volumes that will readily fill a three-foot shelf. More than two hundred papers are represented in these abstracts, of themselves a monument to the activity of the laboratory.

In all this it is to be remembered that Onnes has been busy in his corner of science for the benefit of knowledge, and save in a rare spectacular moment like that of liquefying helium, has kept out of the "spotlight" of popular publicity. He has been thus practically unknown to the people and even to workers in other branches of science. He has been doing this for thirty years, actuated by the most classic of motives. The world rejoices, therefore, that distinction has sought him out, the splendid reward of merit that the Nobel prizes imply. All honor to Onnes, diligent and productive worker in an unheralded section of science.

## Hydraulic Fill Dam for an Earthquake Region

*(Concluded from page 154.)*

the dam is borrowed from the hillside adjacent and from the valley floor of the reservoir site, the material lowest in elevation being placed in the base of the dam. The material is excavated by means of hydraulic jets with nozzles ranging from 1¾ inches to 5 inches in diameter and with a pressure of from 60 to 80 pounds at the jet. Groups of small nozzles are attached to a 4-inch hose for work in the lighter material, so that moves may be made quickly. But for the more difficult material, two great monitors are employed, and it takes from half a day to a day to move these giants into new positions.

As the material is excavated it is carried in suspension down to a sump, where it is picked up by 12-inch centrifugal dredger pumps and carried to either toe of the dam. The material discharged at the toes runs toward the center of the dam, where a pond is maintained at the desired height. The large gravel stops at the toe, and the water graduates the material in fineness as it approaches the central pond. Thus, in this pond only clay is deposited, forming a water-tight core for the dam, the thickness of which is regulated by the central pond. During the period of low water, the surplus water from the sluicing is returned above the dam for re-use after it has deposited its load of material.

At the intake of the culvert a reinforced concrete intake tower is being built. This will be tapered, having an internal diameter of 19 feet at the bottom and 10 feet at the top. This has been especially designed against forces due to earthquakes, a matter of considerable importance in view of the fact that the dam itself is located about half a mile from a very large fault.

When the dam is completed it will provide a reservoir of 1,833 acres with an average depth of 88.7 feet, having a tributary catchment area of 100 square miles, which may be extended later to 140 square miles. The catchment area ranges from 800 feet above sea level, which, of course, is the elevation of the dam, to 4,000 feet, and has an average normal precipitation of about 28 inches per season. The capacity of the reservoir will be 53,000,000,000 gallons at flow line.

We are indebted to Mr. F. C. Herrmann (who, with Mr. William Mulhollant, designed the dam) for the photographs here reproduced.

## Doing Without Europe

*(Concluded from page 157.)*

assume that the yield of potassium chloride could be made to surpass the entire present consumption of potash salts in this country. Counting in Alaska the annual yield might possibly be several times this amount. But there are a number of factors not yet sufficiently well known or understood to make possible any more than tentative estimates."

A characteristic of the "potash from kelp" propaganda is that large capital is quite unnecessary. A very modest outlay for harvester, dryer, and working capital is required.

That a large growth of kelp exists, capable of producing an enormous tonnage of potash salts, has been demonstrated. It has also been demonstrated that kelp can be harvested and prepared for market at a cost commercially practicable. A business in kelp actually exists, though small. It remains to be proven that a stable business, capable of meeting the national necessities, can be established, and to this

end should be lent all possible assistance from Federal and State governmental activities and private enterprise.

**The Farmer is Helped by the Government. Why Not the Metal Manufacturer?**

If the industries dependent on German potash are likely to benefit from the scientific work which the Government has done to develop a potash industry at home, it is due not to any lively interest in the welfare of the manufacturer as in the prosperity of the farmer. American farmers have received practically everything they have demanded from Congress. They are exempt from the operation of the anti-trust laws; they may form combinations for their own benefit, establish co-operative selling organizations and may legally employ most of the devices of the old trusts. Thanks to liberal appropriations our Department of Agriculture has become the largest organization of its kind in the world. Millions are spent annually in teaching the farmer everything that he ought to know, from building fences and raising pigs to the scientific application of Mendel's laws of heredity and the best way of plowing by machinery. This is as it should be. The work of the Department of Agriculture would be a credit to congressional foresight were it not more a tribute to political astuteness.

## The United States an Undefended Treasure Land

*(Concluded from page 159.)*

equipment. On the contrary, every effort should be made to secure, even at a somewhat added cost, manufacture of field guns, ammunition, small arms and equipment, by outside firms, so that, in case of any sudden emergency, there may be agencies other than the arsenals which have the machinery and, what is equally important, the trained *personnel* to meet the needs of the Government. No economy can be more unwise than that which concentrates in the hands of the Government the entire manufacture of articles of military equipment, and no policy will tend more to establish a condition of inability to meet the demands of war than such a one.

**We Have Practically No Reserve of Uniforms, Tents, Transportation Equipment and Other Military Supplies.**

In other departments (uniforms, tentage, etc.) we are practically without a reserve of materials, worthy of the name, considering the demands which must be met, and met promptly. We have no ammunition trains, no general reserve of transportation or other military supplies, and no adequate plans to supply them. All this is being left to be prepared in the hurry and confusion of war.

**That "Undeveloped Military Resources" Fallacy.**

Our people are prone to speak of our undeveloped military resources. These are of value if we have time to develop them, but in the onrush of a modern war are of little more value than a deep-lying coal vein to a freezing community in a Nebraska blizzard, and reference to them as a military asset of value, when it is remembered that all our possible enemies are dangerous enemies and prepared to the minute, is just about as intelligent and as much appreciated by those who understand what preparation means, as would be advice to the freezing people to use the unmined coal one hundred feet under their feet.

**Wars Are Sudden, and the Ocean Renders Attack Easy and the Point of Attack Doubtful.**

Wars in these times come with great suddenness. The ocean, instead of being a barrier, is one of the readiest and most convenient means of approach. We have an enormous coast line unprotected, except at the mouths of our harbors, and even these are unprotected against an enemy who lands outside the range of their guns.

**We Have Only One Half of the Force Necessary to Man the Coast Fortifications With Even One Relief.**

The existing regular coast artillery force, even with the existing reserve coast artillery militia, is entirely insufficient to man the existing works and give even one relief. Indeed, these forces combined amount to but little more than one half the force necessary to accomplish this. The idea has been advanced that the coast defenses could be adequately manned by a judicious transfer of *personnel* based upon an enemy's movements. This is, of course, absurd. As the attack would come from the sea, the whereabouts and movements of the enemy would be unknown, and once off the point of attack there would be no opportunity through judicious transfer of troops to meet the attack until several days after it was finished. No, quite the contrary is the policy which must be followed. In time of war all fortifications on the sea coast of the ocean over which the enemy will operate must be completely manned, and with a full supply of ammunition. Any other policy is lacking in appreciation of the needs of the situation. If the attack involves both oceans, then the entire sea coast of the United States will have to be maintained in a condition of defense, and an adequate force of men and supply of ammunition will be required in every work.

It must be remembered that our expensive system of sea coast fortifications will be practically useless as a means of defense unless supported by an adequate mobile force. The term "coast defense" is a misnomer and conveys to the general public a false impression. It is only an element of defense, and unless supplemented by a mobile force will be of little value in preventing an invasion of the country. It may prevent bombardment of harbors and towns behind them by fleets, but never can, without the mobile army, prevent the more serious feature of war, namely, territorial invasion and occupation. Sea coast fortifications will not prevent an enemy from landing on our shores and seizing and occupying what he wants; this can only be prevented by an adequate mobile force. We have no such force.

We have a miniature fighting force, a population unused to arms, without organization, filled with an enormous conceit as to their military ability, which is unjustified by history. The question is, What shall be done to better the present situation?

**The Urgent Need of the Hour.**

In the first place, we must provide a reserve behind the regular army and militia as above indicated, and provide the regular army and the militia with the organizations necessary to complete them, and also provide the necessary field artillery guns and ammunition, ammunition trains and other supplies which cannot be promptly procured in the open market. It is probable that the States will feel with reference to the reserve and to the special arms, such as cavalry and field artillery, that these are for national uses and must be supplied and maintained by the Federal Government. So be it. If the States are not able, they must be helped. Without these vitally important organizations, neither the regular army nor militia will be efficient. Artillery has become such a dominant feature in the modern battle field that to send troops into campaign without a proper proportion of this arm would be suicidal. Any nation which neglects to provide this important, nay, vital arm, in liberal proportion, courts disaster and wantonly wastes the lives of its people.

In fact, troops without artillery are, against troops provided with this arm, no better off than if armed with spears, until they get within a range of 1,200 yards.

---

**Musical Chimes for Doors.**—A pleasing novelty has been devised in France to take the place of the jingling alarm bells on doors. A plate screwed on the top of the door serves as the base for a projecting rod or bracket from which hang a set of chimes. On the end of the bracket is a flat disk, and around the disk are suspended several sonorous metal tubes, of different lengths or pitches. In the middle is a striker disk suspended by a cord. When the door is opened, the chimes are set in movement, and a pleasing effect is the result.

# SCIENTIFIC AMERICAN

THE PHONOGRAPH LEAVES THE AIR-SCOUT'S HANDS UNHAMPERED.—[See page 175.]

Vol. CXII. No. 8
February 20, 1915

Munn & Co., Inc., Publishers
New York, N. Y.

Price 10 Cents
$3.00 A Year

SEVENTY-FIRST YEAR

# SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

VOLUME CXII.
NUMBER 8.

NEW YORK, FEBRUARY 20, 1915

10 CENTS A COPY
$3.00 A YEAR

## New York's Greatest Lighting Spectacle

By Charles W. Person

WHEN the sixty-storied Woolworth structure was nearing completion, Cass Gilbert, who was employed to prepare the architect's drawings, went to F. W. Woolworth's office with a big roll of plans in his arms.

"How high do you want the tower now?" asked Mr. Gilbert.

"How high can you make it?" questioned Mr. Woolworth.

"It is for you to make the limit," said Mr. Gilbert.

Mr. Woolworth was silent. The Metropolitan tower had just been run into the air, overtopping the Singer building. At that particular moment he had on his desk the exact measurements of the Metropolitan tower. Studying these figures a moment, he turned to Mr. Gilbert.

"Then make it at least fifty feet higher than the Metropolitan tower," said he.

That is one chapter in the interesting story explaining how the Woolworth building came to be day king of New York's skyline. That was a distinction of no little importance, but sad to relate, it was short-lived, for with the coming night the huge structure was swallowed up in darkness and robbed of its glory. To the south appeared the real night king of the skyline—a lesser king, to be sure, but none the less real—in the form of the Singer tower, strung and studded with lights. The eyes that admired the Woolworth tower by day left it to admire the Singer tower by night.

Thus it was that New York's skyline paid homage to two kings, that is, until New Year's night, when the day king burst from the black night a great crystal of flaming light, causing all the other lighting spectacles of the metropolis to fade away before it. The thirty stories, comprising the tower of the Woolworth building, form the most wonderful permanent lighting spectacle in the world at the present time.

Illuminating building exteriors is not a new feat to New Yorkers. In the past structures have been illuminated by bringing into prominence certain lines and architectural details, obliterating in large measure the other surfaces. Lighting of this character had been installed in connection with the safe and sane Fourth of July celebration, but the results did not best befit the beauty and dignity of the Woolworth building. Mr. F. W. Woolworth, before giving orders for the installation, had his eyes on the Singer tower, just as he had his eyes on the Metropolitan tower before he told Mr. Gilbert to go ahead with the building plans. It was his desire to engineer a lighting spectacle that would not only be original, but gigantic.

A string of incandescent bulbs or a series of strings was out of the question, so it was decided at the start to light the entire surfaces of four sides of the tower from the thirtieth to the sixtieth floor and make the installation a permanent one. It took 50,000 feet of conduit from ½ to 3 inches in diameter, 16,400 feet of 500,000 C. M. cable, and 50,000 feet of No. 14 duplex wire to complete the installation.

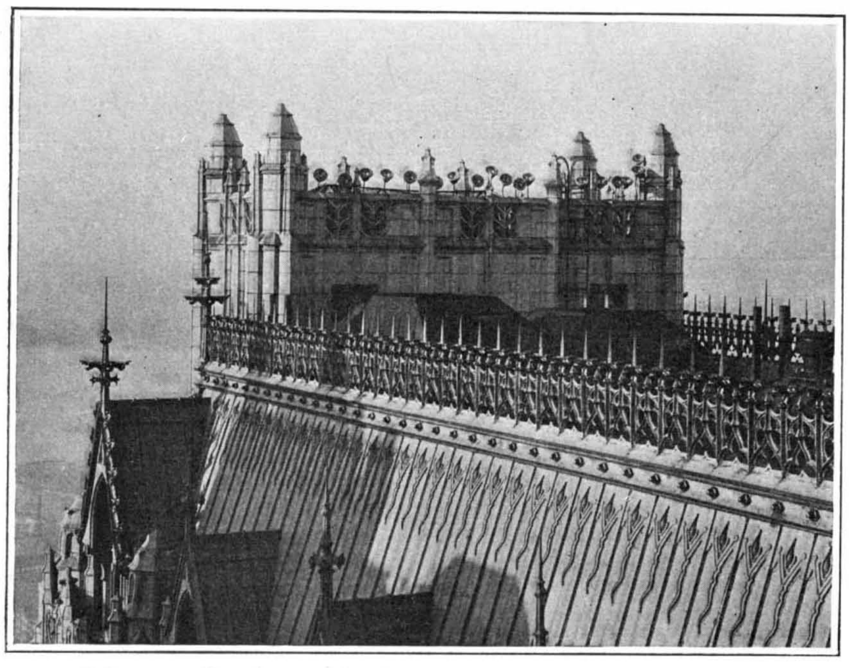
On account of the great height and to insure uniform lighting, projectors—ordinary automobile lamps of the largest size—were used. It required six hundred of these projectors, each with a 250-watt lamp of the new gas-filled type with closely concentrated filament, to play light upon the four sides of the thirty-storied tower. In addition to these six hundred projectors twenty-four 1,000-watt lamps were placed in the topmost point of the tower, called the lantern or crow's nest, to give the effect of a great scintillating jewel. The total power consumed is 175 kilowatts—more light than is usually employed in lighting the streets of a city of 30,000 inhabitants.

The projectors are arranged in batteries at vantage points, and so placed that the rays from one set shoot upward along the sides of the tower, and the spaces not touched by this set are played upon by another set arranged on the floors above which direct their rays downward. Thus there is one continual diffusion of light. To prevent anyone in the street from determining the sources of the light, screens are used.

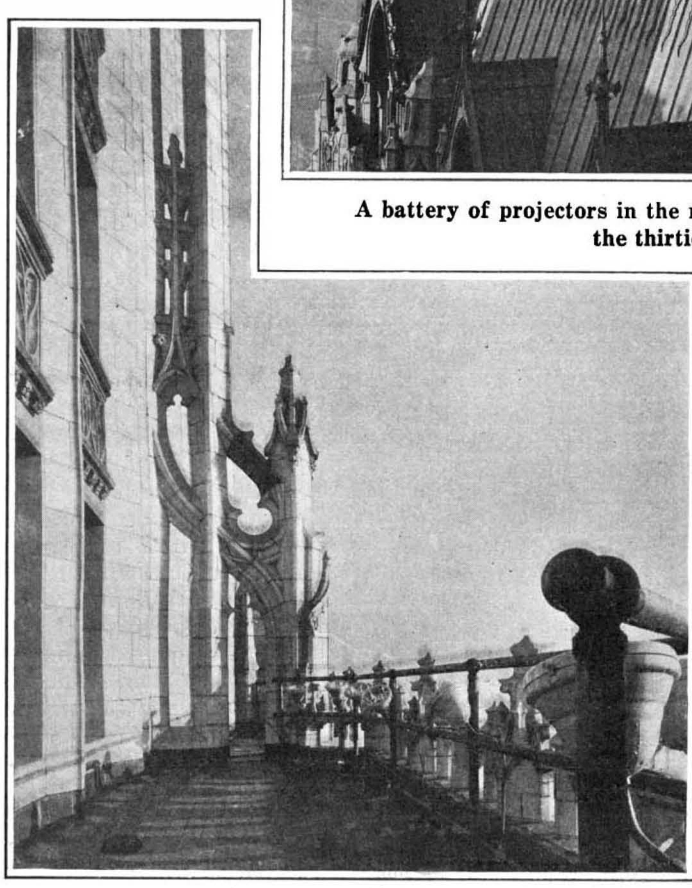
The projectors are distributed in the following manner: Two sets are placed on the north and south wings of the pent houses at the thirtieth floor to light the west side of the tower as far as the forty-third floor. The north and south sides of the tower are bathed in light from the thirtieth to the forty-third floor by a set placed on the gabled roofs at the thirtieth floor. The east side had to be lighted from a set placed on a narrow balcony opposite the twenty-seventh floor. This is the method employed to shoot light upward, so at the forty-third floor a similar set of projectors is placed which plays light on any spots not touched by the projectors at the thirtieth floor.

From the forty-third and forty-ninth floors projectors are focused up as far as the fifty-third floor, or beginning of the Mansard roof. Another set is placed at this floor to illuminate the Mansard roof. Opposite the fifty-fourth floor four sets are placed which play upon the observation balcony at the fifty-eighth floor, or 750 feet above the pavement. But the most novel feature of the whole installation is two stories above—the sixtieth floor—which is the crow's nest or lantern. It is inclosed with diffusing glass and within the lantern itself, which is a very small affair, and is a mere 792 feet 1 inch above Broadway, are placed the twenty powerful lamps. Connected with these lamps is an automatic dimmer, which continually alters their intensity in an irregular cycle. The glass surface of the lantern gives the jeweled effect of a deep red glow no brighter than the adjacent gilded structure, and again it flares to a bright white light of fifty times this intensity.

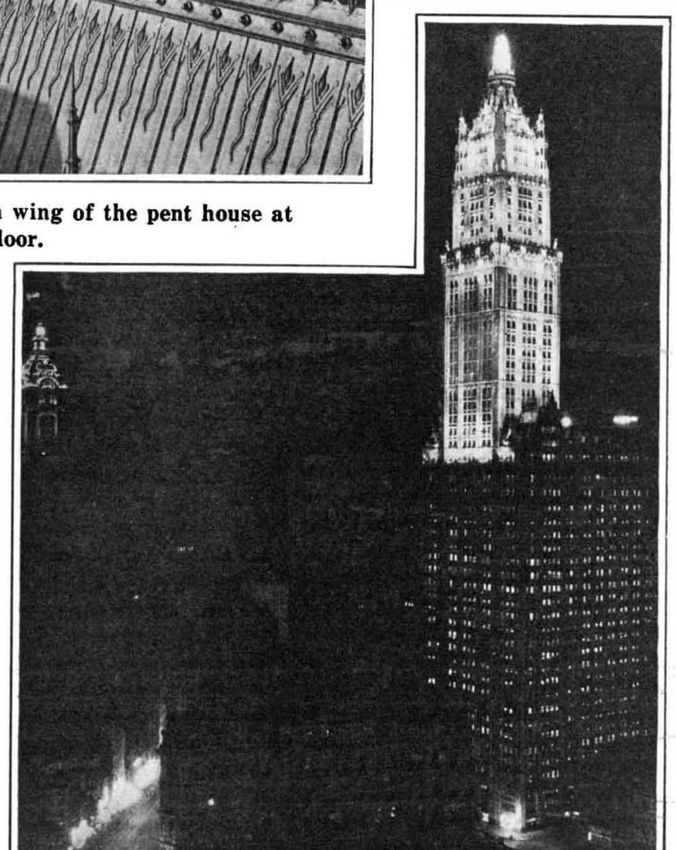
Forty engineers and a dozen electrical experts worked for months making the installation bring out in architectural detail the hidden recesses, the balconies, pent houses, Mansard roof, observation balcony, and lantern. The reflecting characteristics of the glazed terra cotta surface of the building and the necessity for mounting the large amount of material equipment in a few restricted locations of the tower itself caused unusual difficulties in the design of the lighting scheme.



A battery of projectors in the north wing of the pent house at the thirtieth floor.



Projectors on the twenty-seventh floor that throw light to the forty-third story.



The Woolworth tower as it appears at night. The Singer tower is shown at the left.

**First Award of the Anthony N. Brady Safety Medal.**—Early last year the family authorized the annual award by the American Museum of Safety of a gold medal to the American electric railway company which for the year had done the most to conserve the safety and health of the public and its employees, and the first of these medals has just been awarded to the Boston Elevated Railway Company. Besides the principal medal two replicas, one in silver and one in bronze, are also given respectively to the member of the operating staff and to the employee who contributed most to the successful record of the company. These medals were given to Russell Adams Sears, vice-president of the road, and to Henry V. Neal, a mechanic in the shops, who had served on the Safety Committee, and whose system in the shops had reduced the record of accidents by 19.6 per cent during the year. This is the only case where a workman in an establishment has received such a recognition. It should encourage the men to work out safety methods.

# SCIENTIFIC AMERICAN

**Founded 1845**

**NEW YORK, SATURDAY, FEBRUARY 20, 1915**

Published by Munn & Co., Incorporated. Charles Allen Munn, President; Frederick Converse Beach, Secretary
Orson D. Munn, Treasurer
all at 361 Broadway, New York

Entered at the Post Office of New York, N. Y., as Second Class Matter
Entered as Second Class Matter at the Post Office Department, Canada.





**Subscription Rates**

| | |
|---|---|
| Subscription one year .................................. | $3.00 |
| Postage prepaid in United States and possessions. Mexico, Cuba, and Panama | |
| Subscriptions for Foreign Countries, one year, postage prepaid, | 4.50 |
| Subscriptions for Canada, one year, postage prepaid ......... | 3.75 |

**The Scientific American Publications**

| | |
|---|---|
| Scientific American (established 1845) .......... per year. | $3.00 |
| Scientific American Supplement established 1876. " " | 5.00 |
| American Homes and Gardens ................ " " | 3.00 |

The combined subscription rates and rates to foreign countries including Canada, will be furnished upon application.
Remit by postal or express money order, bank draft or check

**Munn & Co., Inc., 361 Broadway, New York**

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp* the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.


*The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.*

## The Administration View of the Shipping Bill

THE attitude of the SCIENTIFIC AMERICAN to the Ship Purchase Bill (a measure which has thrown Congress into a deadlock as remarkable as any that has ever occurred) must, by this time, be perfectly clear to its readers. Our opposition to the bill is the outcome of many years of study of the problem of our merchant marine, and it is based upon a serious conviction that the Administration measure does violence to certain fundamental economic and political principles, the violation of which is certain to doom this or any other specious and ephemeral enterprise of the kind to disastrous failure.

At the same time we realize that it will greatly assist our readers in arriving at a more just conclusion as to the merits of the bill, if both sides of the controversy are laid before them clearly and, as far as possible, wthout prejudice. The arguments of the opposition to the measure we have endeavored to make clear in the series of articles which have appeared in our columns during the discussion of the bill.

It now gives us great pleasure to present elsewhere in this issue an article written at our request by Representative Joshua W. Alexander, Chairman of the House Committee on Merchant Marine and Fisheries, who introduced the Ship Purchase Bill in the House. The article has all the force, logical sequence, and clarity of statement, which one would expect from Judge Alexander in the summing up of an important case. No one can read his statement without being possessed of a perfectly clear understanding of the motives, underlying principles, scope and purpose of this measure. We now can follow, intelligently, the sequence of external events and internal mental processes which led the Administration, after a survey of the conditions existing in our merchant marine and our oversea commerce, to present this measure as the very best which it can offer as a solution of the present difficulties.

The demands of editorial courtesy prohibit us from making any detailed criticism of Judge Alexander's article, at least at the present time. In the following issue of the SCIENTIFIC AMERICAN, however, we hope to publish an article by one of the leading opponents of the bill, and at that time we shall make a detailed comparison of the arguments as set forth by the two great parties to the struggle which is now being waged in Congress.

## "An Undefended Treasure Land"

THE series of articles on our military unpreparedness which is now running in the SCIENTIFIC AMERICAN is a plea for an adequate National Police to protect the lives and property of the citizens of the United States, and render conditions so secure that they can live their daily lives and work out their national ideas in peace and quiet. New York city has a municipal police force of about ten thousand—a body of professional men specially trained for their work of preserving the peace and protecting the lives and property of the citizens. At the present time the whole of the United States possesses a national police force of only 30,000 professional soldiers.

Now, the 10,000 men of the New York police force are always within easy call of one another and of headquarters, and in the event of violence on the part of the criminal element of the population, or of a riot by collective bodies of men, they are in a position instantly to master the situation and restore order. The 30,000 regulars of the United States Army, which constitute our national police force, are scattered throughout the length and breadth of our vast country, and in the event of sudden attack by some nation prompted either by ambition for conquest or by fancied grievances, it would take a month or more to concentrate this little force in any number for concerted action against the enemy.

In addition to the 30,000 men of our national police force, we have a special police force, our militia, also widely scattered, of 60,000 effectives, which may be said to answer roughly to the special constables, deputies, etc., which in small towns or communities are sworn in to assist the regular police force, when a disturbance is larger than they can handle. Now, if 10,000 men are needed to protect 5,000,000 people against sporadic and unrelated attempts at violence, by what process of reasoning has this country come to the conclusion that 30,000 regular police and 60,000 special citizen constables are sufficient to protect the 100,000,000 people of this country against the concerted, highly intelligent, and thoroughly prepared acts of violence of some foreign power?

The only possible excuse for not providing a national police in the form of an adequate regular army and militia would be the absolute certainty that no foreign power could possibly have any cause of quarrel with the United States which would lead that country to carry the war into our territory. But on what earthly grounds can we lay claim to such immunity? Is it not a fact that at this very moment our Government is trying (or rather is supposed to be trying) to steer the ship of state on the very edge of the maelstrom of war, without being drawn into its vortex? Again, to predict that this great war will be the last war, that it is merely a tragic prologue to an eternal peace; to shut one's eyes entirely to things as they are, and to indulge in mere Utopian dreaming—such an attitude would presuppose the creation of a new world inhabited by a totally different race.

Now what this country needs, and what its highest military advisers recommend, is that we shall provide a well equipped army, of regulars and militia, of sufficient size to act as a national police force. Just that, and nothing more, is called for in the various reports of the General Staff and in the recommendations of the bureau officials of the War Department.

The series of articles running under the caption "An Undefended Treasure Land" contains the absolute facts concerning the present all but defenseless condition of the United States. These facts have been obtained from the highest officials of the War Department. Every one of them is true; in no single instance has there been the slightest exaggeration. We commend this series to the careful reading of the public, and especially do we commend it to the consideration of those Congressmen whose indifference or blind opposition is responsible, more than anything else, for the present deplorable military situation.

## Weight of Metal Versus Volume of Fire

ONE of the long-standing controversies in which the opposite sides have reached a common conclusion is that regarding the best kind of main armament for battleships. Some have held that the delivery of a large volume of fire of shells of moderate caliber, others that a smaller volume of fire of shells of greater weight is preferable. The former school found its chief support in the German navy, and the first battleships of their modern fleet carried nothing larger than the 9.4-inch gun, the ten battleships of the "Kaiser Friedrich III" and "Wittelsbach" classes mounting this piece in their main batteries.

It was not until 1904 that they completed in the "Braunschweig" a battleship mounting 11-inch guns, and eighteen of their battleships and battle-cruisers, completed between that date and 1911, had no gun heavier than this. In 1911 and 1912 they set afloat four ships of the "Thuringen" class mounting 12-inch guns, and these ships were followed by five vessels of the "Kaiser" class mounting the same piece. During all these years our own and the British navy were mounting the 12-inch, the 13.5-inch, and the 14-inch, and in the case of the British, the 15-inch gun.

The 15-inch gun was first mounted in the "Queen Elizabeth," completed last year, and by the end of the present year Great Britain will have completed eleven ships of the "Queen Elizabeth" and "Royal Sovereign" classes, each mounting eight 15-inch guns. That Germany has at last come down to the prevailing opinion is shown by the fact that her latest dreadnoughts of the "Friedrich III" class, to be completed in 1916 and 1917, each carry eight 15-inch guns of a type recently developed for naval purposes.

Comparing the weight of the individual shells, we find that the earlier German battleships threw one of 420 pounds weight from their 9.4-inch guns, against one of 850 pounds weight from the British 12-inch of that date; that the German 11-inch gun of the intermediate period fired a 650-pound shell from the 11-inch gun against shells of 860 pounds and 1,400 pounds delivered, respectively, by the British 12-inch and 13.5-inch guns; and that their latest ships in commission, of the "Kaiser" class, oppose an 860-pound shell from their 12-inch guns to the 1,920-pound shell of the British 15-inch guns mounted on the "Queen Elizabeth" class.

In explanation of the German preference for lighter guns, it has frequently been stated that those responsible for German naval ordnance believed that a greater volume of light shells would prove to be more effective than a smaller volume of heavier projectiles. This theory, if it existed, was held in the days when it was believed that, because of the generally hazy conditions in the North Sea, engagements would be fought at from 6,000 to 8,000 yards range. If these ranges had obtained there would be some force to the German theory; but the war has demonstrated that the admiral of a fleet, if he possesses the speed gage, will fight at the maximum range at which he can land effectively on the enemy. There has been one notable case in which the Germans failed to use an opportunity to put their theory to the test, namely, in the recent battle-cruiser fight in the North Sea. Here the German battle-cruisers, had they closed in to a range, say, of 9,000 to 10,000 yards, would have been in a position to perforate the 8- and 9-inch belts of the British battle-cruisers with their high velocity 50-caliber 11-inch guns, to say nothing of the 50-caliber 12-inch pieces carried by the "Derfflinger." At these ranges the greater rapidity of fire of the 11-inch guns would, under the German theory, have compensated considerably for the slower fire of the heavier and more numerous English pieces, particularly as the German ships are generally believed to carry much heavier belt armor. That they made a running fight of it, and left the "Bluecher" to its fate, indicates that the Germans believed victory would inevitably rest with the ships carrying the heavier guns.

## Emotionalized Science

WHAT would the world think of a modern astronomer or physicist or botanist who should, after the example of Parmenides and Lucretius, compose a treatise on his science in verse? It is safe to say that the poem would not be read by lovers of poetry on the ground that the subject was not poetical, nor by students of science on the ground that one who is a poet is, *ipso facto*, too flighty a person to meddle with scientific matters. Yet there is ample evidence, even in modern literature, to prove that the wisdom of science may be married, with the happiest results, to immortal verse; and again, that neither poetry which ignores science nor science which rides roughshod over poetic moods and aspirations can be regarded as a particularly pleasing or wholesome product of the human mind.

When the Eiffel Tower was erected a storm of protest arose from the artistic world of Paris. The tower was not beautiful according to canons of taste formulated in an age which knew nothing of steel construction. To-day critics generally admit that the tower *is* beautiful, because every line has a structural meaning and every part is adjusted with marvelous skill so as to secure maximum strength with a minimum of material.

Science is essentially romantic. To-day the world stands spellbound before it, and would laugh to scorn a twentieth century Keats who should assert that "all charms fly at the mere touch of cold Philosophy" or raise a puerile lament at the unriddling of the rainbow. If we are sorry for Keats, it is not because science robbed him of his "awful rainbow once in heaven," but because he was blind to the immeasurably more awful meteor erected in its place by Newton and Young. Knowledge, coupled with the romantic temperament, leads to the highest delights of the spirit. Compare the formless yearnings of a poet to whom the starry canopy is little more than scenery and mystery with the overwhelming emotions of the astronomer in the presence of the universe. "I do think the thoughts of God!" exclaimed Kepler.

It seems rather banal to say that Tennyson carried farther than any other poet the dual task of utilizing scientific truths for the purely esthetic purposes of poetry and of infusing the spirit of poetry into the science of his day, or to revive the memory of his beneficent work in softening the shock of iconoclastic revelations; yet we believe that many scientific men to-day hardly realize how much a great poet can do for science by emphasizing its emotional aspects.

Tennyson's well-known trick of mingling scientific and classical allusions—the latest revelation of the telescope with an echo from Hesiod or Theocritus—was a *tour de force* only as a violent departure from conventional methods in poetry and not because of any essential incongruity in the things thus brought together.

Tennyson put the circular theory of storms into the lines

> Across the whirlwind's heart of peace,
> And to and thro' the counter-gale;

but did not Goethe put Luke Howard and his cloud-classification bodily into a poem?

## Electricity

**Introducing Electric Flatirons in South America.**—The enterprising public utilities company of Rio de Janeiro, endeavoring to encourage the use of electricity in the household, has adopted the policy of giving an electric flatiron free with each gas stove purchased within a certain period. The experiment is declared to be very successful.

**Iron v. Copper Wire in Germany.**—Because large quantities of copper are used in the manufacture of ammunition for the German army and because the war has restricted the import of that metal, the German Association of Electrical Engineers has issued an announcement recommending the use of iron wire instead of copper wherev possible. The substitution can readily be carried out in direct current installation, but where alternating current is used, it introduces complications because of the skin effect and the increased impedance.

**Electric Water Heater.**—A very compact little electric stove has been put on the market which is particularly adapted for heating a tumbler or glassful of water in a very short space of time. The heating element is in the form of a cylinder, slightly under an inch in diameter and about 4½ inches long, which is provided with a metal cap arranged to fit over the mouth of the glass This serves to retain the heat and also keep out dust and dirt. The switch in the cover controls the current. The heating element generates sufficient heat to bring a glass of water to a boil in a minute and a half. The device consumes 450 watts.

**Electric Lamps in the United States.**—According to a recent report of the Bureau of the Census, in 1912 there were 560,981 arc lamps wired for service in use in the United States, as against 85,557,819 incandescent lamps. The number of arc lamps showed a drop of about 55,000 since 1907 while the incandescent lamps showed a gain of nearly forty million. The number of electric lamps used for street lighting in 1912 is given as 348,643 arc lamps and 681,379 incandescent lamps. The geographical distribution of the lamps shows nearly eight million for the New England division, twenty-two million for Middle Atlantic, nearly nineteen million for East North Central, eight million for West North Central, nearly four million for South Atlantic, two million for East South Central, three million for West South Central, two million for Mountain and nearly eight million for the Pacific division.

**Emergency Street Lamps.**—Apparently Chicago is so accustomed to having joy riders run amuck on its boulevards at night, and wreck its lamp posts, that it has provided emergency lamp posts to be used on such occasions. The lamps that furnish the special object of attack for the rollicking, devil-may-care motorist are those located at street corners in the so-called "Isles of Safety." Surely this is a misnomer so far as the lamps are concerned. But, be that as it may, there can be no doubt that after the lamp has been smashed these concrete obstacles in the middle of the avenue become a dangerous menace to the careful driver as well as to the reckless one. Accordingly, emergency lamps are kept on hand which may be set in place at once. The lamp post consists of a gas pipe standard attached to a hand-hole cover fitted with fuses and connection terminals. Spring leaves on the cover serve to hold the post upright when they are forced into the hand-hole. At the top of the post are four carbon-filament lamps inclosed in a red globe. This serves as a light-buoy for the rock in the path of navigation. However, it would seem as if the Isles of Safety could be turned into real refuges for pedestrians were they better fortified against attack.

**High-lift Centrifugal Pumps.**—Electric motors for pumping purposes are now used to good advantage for high lifts, and the new turbine pumps for such combinations are said to be much better than piston pumps which were hitherto used. Formerly centrifugal pumps were only used for low lifts, but the modern multiple stage pump can be designed to pump against a head of 3,000 feet or more, and the limit in this direction is as unrestricted as with any form of plunger pump. Again, the efficiency compares favorably with that of the latter type. But a great advantage lies in coupling to high-speed electric motors or steam turbines. As an example, we have a mine pump group for delivering 670 gallons per minute against a head of 1,500 feet, the speed being 1,485 revolutions per minute. An electric motor occupies the middle of a long foundation plate, with a turbine pump coupled on each side. Pumps of this class often have five stages, the water passing into five successive chambers with a turbine wheel in each, so that each stage adds more pressure to the water, and it thus leaves the pump at a high pressure. Other uses are for feed pumps for steam boilers, for blast furnaces, and the like. A good example of a large double pump with electric motor is seen in the type of colliery pump which is capable of lifting 1,150 gallons per minute to a height of 2,420 feet when running at 1,485 revolutions per minute. Between the two pumps is mounted on separate foundations a three-phase, 1,250 horse-power, 5,000-volt electric motor. The present system is of English make.

## Science

**Bacteriological Examinations of Hamburger Steak.**—In two recent contributions to the *American Journal of Public Health* Messrs. Weinzirl and Newton describe a new method of determining the bacterial content of meat, in which the meat is ground in a mortar with sterile sand and normal salt solution to obtain an emulsion for inoculation into the culture media, and report the application of this method to the determination of the bacterial content of a number of samples of market Hamburger steak. The result showed that the standard of 1,000,000 bacteria per gramme sometimes advocated as a maximum limit for the salable product is much too low, as nearly all the samples examined would be condemned on this basis, though showing no taint or other evidences of putrefaction. The authors propose a limit of 10,000,000 bacteria per gramme, though even on this basis about 50 per cent of the market samples of Hamburger steak would still be condemned.

**The Book of the One-armed.**—Of interest in this era of war when so many men are maimed one way or another is the "Book of the One-armed," written by Count Géza Zichy and issued in Germany. It is intended to show how men who are one-armed can with a single hand be independent of the help of others. When a young man Count Zichy lost his right arm, yet in spite of this misfortune he has become a distinguished pianist and is known as "the left-handed virtuoso." The count had long wished to narrate his experiences to fellow-sufferers, so as to show them how he had risen above his infirmity and by what means he had managed to depend on himself alone in all that requires hands. The present moment seemed to him the right time to carry out his plan, and he recounts his experiences in the struggle for self-help with an amiable humor which should encourage those who, brave as soldiers or in the ordinary cares of life, are disheartened at a fate that seems to keep them in a constant state of dependence.

**Prof. Benjamin Sharp.**—The announcement was recently received that Prof. Benjamin Sharp, for many years known as a zoologist of note, had recently died at Morehead, S. C., in his fifty-sixth year. Dr. Sharp graduated from Swarthmore College and the Medical School of the University of Pennsylvania, which in 1891 conferred upon him the degree of Ph.D. He continued his studies abroad at the University of Würzburg, which conferred a Doctor's degree upon him, and he also studied at the universities of Berlin and Leipsic, and at the Zoological Station at Naples. Returning to this country he held the professorship of invertebrate zoology at the Philadelphia Academy of Natural Sciences, and at the University of Pennsylvania, and was formerly Corresponding Secretary of the Philadelphia Academy of Natural Sciences. He was with the first Peary expedition to the Arctic, and also did much special work in the Hawaiian and Caribbee Islands.

**Abacá** (Manila hemp) has been for more than a quarter of a century the leading export product of the Philippines, and during part of this time has comprised more than two-thirds of the total value of Philippine exports. The production of this fiber on a commercial scale has always been confined to the Philippine Islands. Recently, however, the prosperity of this industry has been seriously threatened by the increased production elsewhere of machine-cleaned sisal, together with a deterioration in the quality of abacá. While sisal is of generally uniform quality, the output of abacá has been extremely heterogeneous in character, and there was no uniform system of grading and marking. This situation has now been met by the Philippine Legislature which recently enacted a law covering the inspection, grading, and baling of abacá, maguey, sisal, and other fibers, to become effective January 1st, 1915. The subject is discussed in detail in the last quarterly number of the *Philippine Agricultural Review* for 1914, nearly the whole number being devoted to the abacá industry.

**The Smithsonian Tables.**—The recent appearance in a sixth edition of the Smithsonian Physical Tables makes timely a review of the valuable series of publications to which this belongs. In 1852 the Smithsonian Institution published the first edition of the Smithsonian Meteorological Tables, compiled by Dr. Arnold Guyot, primarily for use in connection with the system of meteorological observations established by the Institution about 1850. These tables included much material of general application in physics and were widely used by meteorologists and physicists all over the world. A fourth edition of "Tables, Meteorological and Physical" appeared in 1884, and was a work of much greater size and scope than the original publication. Subsequently it was deemed expedient to subdivide the subject-matter of these tables, and accordingly three independent series were founded; viz., meteorological, physical, and mathematical. The meteorological tables, in the new series, have appeared in four editions, while a fifth is now under consideration. The geographical tables have been issued in three editions. The first separate edition of the physical tables appeared in 1896. Finally, a fourth series is the Smithsonian Mathematical Tables (Hyperbolic Functions), issued in 1909.

## Automobile

**British Daimler to Make Gnome Motors.**—The famous Gnome rotary gasoline motor is to be made in Great Britain during the war by the Daimler Company at Coventry. The Daimler product is rated at 80 horse-power, and is to be used in aeronautical work.

**An Anti-freezing Liquid.**—Many anti-freezing mixtures and preparations have been proposed at various times, but there is one that is seldom mentioned which is said to be excellent in many cases. This is plain kerosene, which will not freeze at any temperature experienced in this country, and also has the advantage that it has a tendency to clean any dirt out of the radiator. It is claimed that kerosene will not in any way injure the majority of radiators; but it should not be used in cars that show a tendency to run hot and boil the water in the radiator, for as kerosene has a lower evaporative point than water it would be wasted rapidly in a hot engine.

**Paris to have Improved Autobuses.**—It is well known that most of the public autobuses in Paris have been taken by the government to serve as military transports, in which work they have proved unexpectedly successful. Even if these vehicles are in condition for further service after the war is over they will not be returned to Paris, but such as can be utilized will be found in the small towns carrying commercial travelers to and fro between the station and the hotel. Already plans have been made for more modern and more elegant buses for Paris, and the new model proposed will be roomier, with higher windows, and will weigh considerably less than the old vehicles.

**Motor Squadrons of England.**—There has been much activity of late in the open spaces around London where military motor squadrons have been practising maneuvers. Each squadron is complete in itself, and consists of a large armored car having a Maxim quick-firing gun mounted in a revolving turret. A second car carries a 1 or 3 pound gun. For these there are two supply cars; and the squadron also includes a red cross car. These combinations are so complete and mobile that they have been found extremely valuable, especially in the skirmishes that so frequently take place in villages. Since the prompt rounding up of DeWet on the occasion of his recent revolt in South Africa, the appreciation of the value of motor cars has greatly increased.

**American Motor Trucks for the War.**—Many items have been going the rounds in regard to orders placed in America by foreign powers for motor trucks to be used in the military operations, Most of the published statements have been erroneous, but in two cases the exact figures for orders thus far received are known. One large concern has contracts for 1,200 trucks of 2-ton capacity, fitted with special bodies; while another equally prominent builder has delivered 300 2-ton trucks and has orders for 300 5-ton trucks for immediate delivery. The purchaser in both of these cases is the French government, which has found the American cars perfectly satisfactory. One of the concerns alluded to also has received an order for trucks from the British Admiralty which is now being filled.

**Keeping Inner Tubes Soft.**—Much money is lost annually by private motorists and by dealers in rubber tires and tubes in small communities, because of the tendency of the rubber tubes to become hard and brittle after a few months of storage. To fold up tubes, cover them with chalk and put them in pasteboard boxes is only a makeshift. They will lose their resiliency after a while. A German rubber manufacturer not long ago furnished to all his dealers instructions as to how best to care for inner tubes. According to these, the best way to preserve tubes is to blow them up to the pressure in an ordinary rubber ball; to hang them upon one or two fairly thick round poles, stretched horizontally, in a darkened room, in which a dish of unslaked lime and one of ammonia solution are placed in the corners on the floor. This arrangement keeps the air free of destructive acids and retards the process of vulcanization which goes on in the tubes.

**Substitutes for Gasoline.**—The efficiency of the German military motor transport service, in which substitutes for gasoline, such as benzole and alcohol, are very extensively employed, is gradually forcing the attention of engineers and investigators to the fuel question, and calling attention to the very material advance that Germany has made in this direction. In America, when cheaper fuel is mentioned to an automobile maker or dealer the reply too often is that the price of gasoline has not gone up, consequently there is no necessity for worry. But how long will this condition last? And in the meantime why should motorists pay twice what they should for fuel? Too many people in the automobile business are so unwise as to persist in regarding their product as a luxury, in regard to which no one should consider the question of expense; but some of the wise business men in the trade are quietly pressing forward their preparations for meeting the new conditions that are sure to come.

# The Sixth Award of the Scientific American Medal for Safety Devices

By William H. Tolman, Director American Museum of Safety

SEVEN years ago the American Museum of Safety was founded by a small group of those interested in safeguarding life and limb from industrial and other accidents. The trustees were largely editors of technical journals, which supported the new movement with great enthusiasm. This movement has grown and grown until we have three Museums of Safety in the United States—one in New York, one in Boston, and one in San Francisco, the two latter being modeled on the parent Museum in New York. The American Museum of Safety has been an inspiration for the entire country and has resulted in the formation of "Safety First" societies, committees, etc., numbering hundreds. Early in the history of the Museum it was felt that some encouragement should be offered to corporations and individuals to invent and install safety devices, as well as to look after the welfare of employees. The SCIENTIFIC AMERICAN was the first to offer a medal for this purpose, and it has now been awarded six times for the most efficient safety device invented within three years of the award and exhibited at the Museum. In the SCIENTIFIC AMERICAN of February 7th, 1914, the first five winning devices were illustrated and described. To recapitulate: The SCIENTIFIC AMERICAN Medal has been awarded as follows:

1908. The Rich Marine Fire Extinguisher Company.
1909. The Patent Scaffolding Company.
1910. The Norton Company.
1912. For the Pulmotor.
1913. The Welin Marine Equipment Company.

The annual exercises and the award of the Museum medals took place on February 10th in the auditorium of the United Engineering Societies Building, President Arthur Williams in the chair. The SCIENTIFIC AMERICAN Medal was awarded first on account of seniority.

The inventor of the winning device is Mr. Glenn S. Williamson, mechanical superintendent of the New York *World*. Mr. Williamson was appalled by an accident in a neighboring building in which a well-known jurist fell in the elevator shaft through an open door to his death thirteen stories below, so he then devised the system illustrated herewith, and this has been operated on several elevators in the *World* Building and also in other tall structures with great success. In awarding the medal, Dr. Frederick R. Hutton, Vice-President and Chairman of the Bureau of Awards, said:

"The general principles on the basis of which the Museum recognizes successful achievement are six in number:

"(1) Applicability. Does the device secure safety for a large number of persons or in a great variety of conditions.

"(2) Practicability. Can the device be used economically and successfully? It must not be too cumbrous or intricate to apply or operate.

"(3) Simplicity. It must not be so complicated that experts are required to handle or keep it in repair.

"(4) Reliability. It must not be liable to derangement or failure to work in emergencies.

"(5) Durability. It must not be so delicate or need such fine adjustment that it will not stand up in service.

"(6) Commercial availability. It must not be too expensive to install or maintain in operation; it must be obtainable in an open market for the use of all.

"The first medal in the history of the Museum to be created and awarded was the SCIENTIFIC AMERICAN Medal. It was first given in 1908, and the foregoing criteria were created to guide the jury in awards in its class. It is given to such individual or corporation as has produced and exhibited in the American Museum of Safety a perfected device of utility which best conserves human life and limb in the processes of productive industry or other avocations. The award this year is given to an individual and the company which he has created to give permanency to his undertakings for a device which shall secure safety to the general public which makes use of the elevator systems in our great office and other buildings, stores, and hotels. It meets the requirements of the conditions of award and is made, in addition, to command the special approval of the jury because it involves and in a most simple and direct way the application of what safety calls 'the interlocking principle.' That is, a construction makes it mechanically impossible to open the hatchway door either from within or without until the car is at the landing or within four inches above or below it. Secondly, it is impossible to start the car from the landing until the hatchway gate is closed entirely or so nearly closed that no part of the human frame can be forced through the opening. For its attainment of mechanical safety and the prevention of obstinate or reckless humanity from doing what it ought not to do, the Museum awards the SCIENTIFIC AMERICAN Medal to


**The Scientific American Medal.**

the Shurloc Elevator Safety Company, Inc., and to Mr. Glenn S. Williamson, the designer of the mechanical details of the device."

A description of the device will prove interesting. Safety of passengers getting on or off elevators can only be assured by three things:

(1) By holding the elevator car immovable at a safe landing while the gate is open.

(2) By locking the gate shut before the car can be moved up or down the shaft.

(3) By keeping the gate shut and locked when the car is away from the landing.

To be effective, these essentials must be mechanically compulsory, as with an interlocking switch and signal, by maintaining a unit of safety at each gate which operates when the car reaches the landing.

In the system here described each unit works independently of all the other units and cannot by any known means tie up or interfere with the regular operation of the elevator, which is an ever-present possibility whenever the locking system is unified with all the doors in the elevator shaft.

The unit of safety in this system is a locking mechanism on the sill in the elevator shaft at the bottom of the gate and to the side of the car. The car carries an equipment by which the lock is operated mechanically from the car, thus controlling the opening of the door.

The accompanying photographs are of a working model of wood, of which the car floor *X* is cut away to show the car equipment and operation.

Fig. 1 shows the Shur-Loc mounted under the gate and the gate locked; also the car equipment with the controller at running position.

Fig. 2 shows the controller locked in a neutral position, the projecting shoe gripped by the retaining bolt, the gate unlocked and opening. The mechanism is shown with its cover removed.

With this system, before anyone can leave or enter the elevator car it must be brought to the landing in front of the gate, the controller must be placed in a neutral position, stopping the car, and then, by simply stepping on the pedal (1) in the car floor near where he stands, the operator *locks* the controller and unlocks the gate.

When he steps on this pedal it raises the locking rod (2) and locks the controller, as shown in the photograph. It also projects the contact shoe (3) against a lug behind 3, forcing back the catch (5), which releases the shoe (6), thereby unlocking the gate. While the gate is unlocked the elevator door may be opened and passengers can leave or enter the car in perfect safety, for the car cannot be moved either up or down while the gate is open or unlocked. The car cannot move because when the shoe (6) was released from the first catch (5) the steel retaining bolt (7) gripped the contact shoe (3) and secured it in its projected position, where it holds up the rod (2) and keeps the controller locked so the car cannot move.

The car cannot be started until the shoe (3) is released, and it can only be released by shutting the gate, which is securely and mechanically locked by the first catch (5) when it gets back in closing to within four inches of the jamb. Here the retaining bolt (7) will instantly release the contact shoe (3) and allow the locking rod (2) to fall by gravity so as to unlock the control and let the operator start his car.

It is obvious that as locking the gate unlocks the controller the car cannot start until after the gate is locked. Consequently, no one can possibly pass through the gate after the car is started. The unlocking of the controller is simultaneous with the locking of the gate, and unlocking the gate and locking the controller are simultaneous with the pressure of the operator's foot on the pedal, which locks the control and unlocks the gate. There is no delay to the elevator. A quick, safe landing and getaway are assured. One pressure of the foot when the car reaches the landing anchors the car and frees the passengers. After the gate is locked on the first latch it takes only a few seconds for it to close the last four inches and again lock tight shut on the second latch. Meanwhile the operator's mind acts, he moves his controller and away goes his car. The entire operation is automatic and mechanical and enacted from the inside of the car while it is stationary at a safe landing. If the operator steps on the pedal while the car is moving anywhere in the shaft the inside spring with which the pedal is provided absorbs the pressure and nothing happens, because the rod cannot be raised nor the shoe projected while the controller is in the running position.

This device has an extra feature, not essential to safety perhaps, but which will appeal to all users of elevators. This is a light to illuminate the threshold of the car while the gate is open. An electric switch controlling a light is fixed under the car in a strong metal box and operated by the same pressure which projects the shoe, thus simultaneously illuminating the threshold of the car when the door is open.

The other medals which were awarded were: The Traveler's Insurance Company's Medal, which was given to the Commonwealth Edison Company of Chicago; the E. H. Harriman Memorial Medals in the railway field, which were awarded to the New York Central Railroad Company; and the Anthony N. Brady Memorial Medals in the street railway field, which were awarded to the Boston Elevated Railway Company.

Hon. Dudley M. Holman made the principal address.

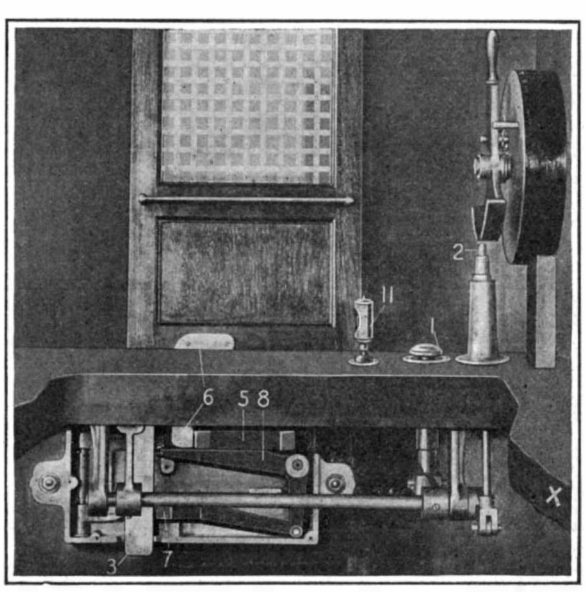



**Fig. 1.—Gate locked and controller in running position.**

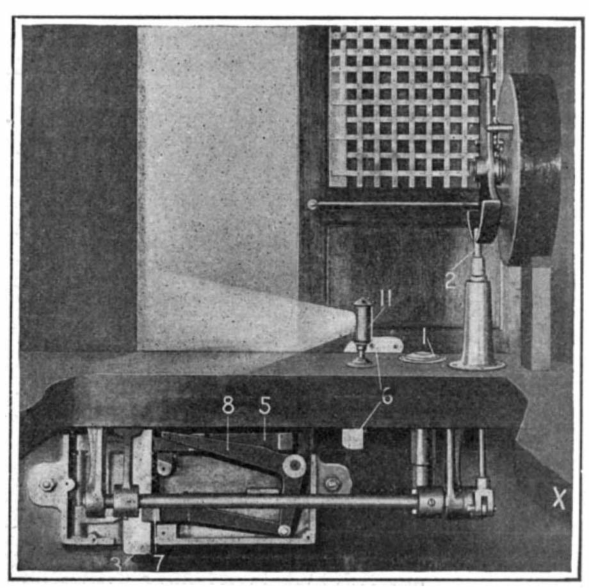


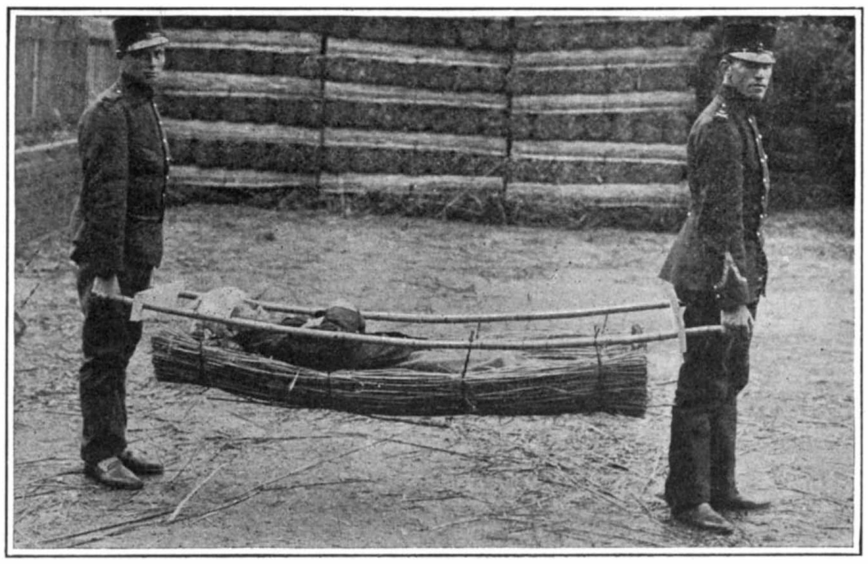

**Fig. 2.—Controller locked in neutral position and gate unlocked.**

## Stretchers of Straw for the Dutch Army

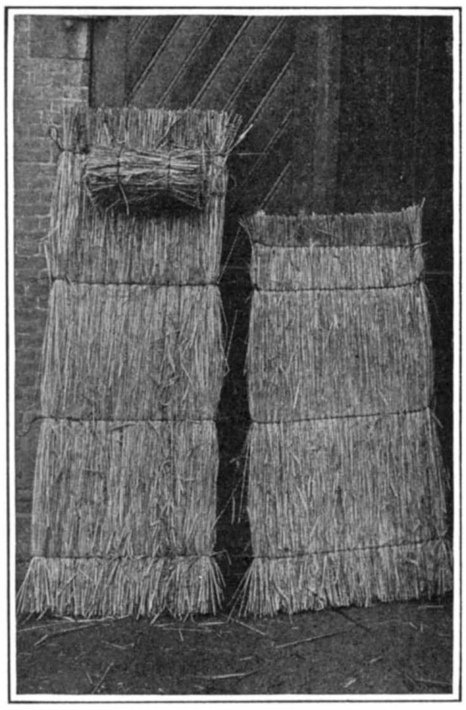
By W. J. L. Kiehl

A NATIVE of Netherlands has invented a very practical stretcher for army use, also a field-bed of similar construction, which will be found very comfortable and warm. The stretcher consists of a mat of straw with a reinforcing of willow or reed on the underside. This is fastened to a couple of bamboo poles which serve as handles. A couple of spacing boards keep the mattress spread out fairly flat when in use, as shown in one of the drawings. A roll of straw serves as a pillow. With the bamboo poles removed the mattress of straw will be found serviceable, as a bed, even on damp ground, and a blanket, also of straw, may be used to keep the sleeper warm.

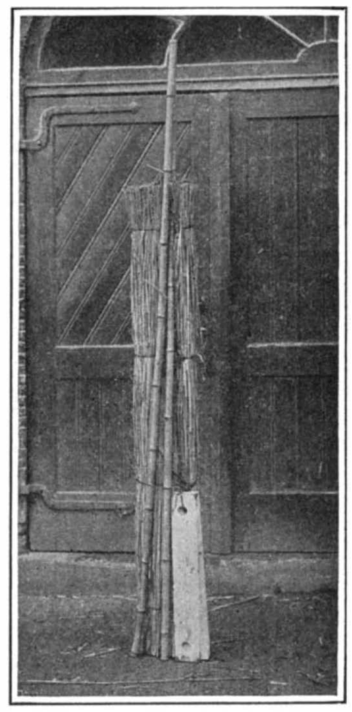
These straw stretchers were first used in conveying the wounded of the British cruisers sunk off Holland's coast, and since then they have seen service on the southern frontiers of Netherlands. Many a sick and wounded Belgian refugee or soldier has stretched his weary limbs on these straw beds. They promise to be especially useful in times of epidemic, for their inexpensiveness allows of their being burnt after use, so that there will be no danger of spreading infection. When not in use they may be rolled up and piled in stacks as shown in one of the photographs.



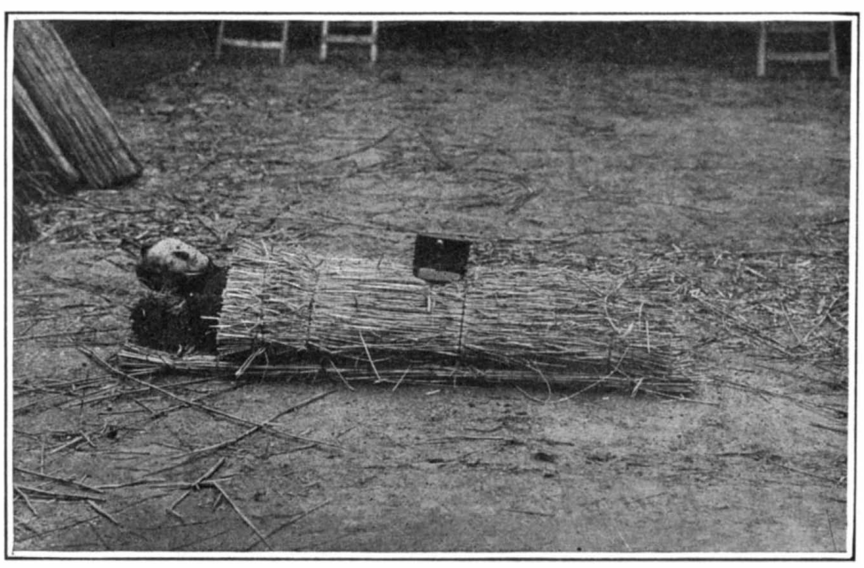
Stretcher of straw used in the Dutch army.



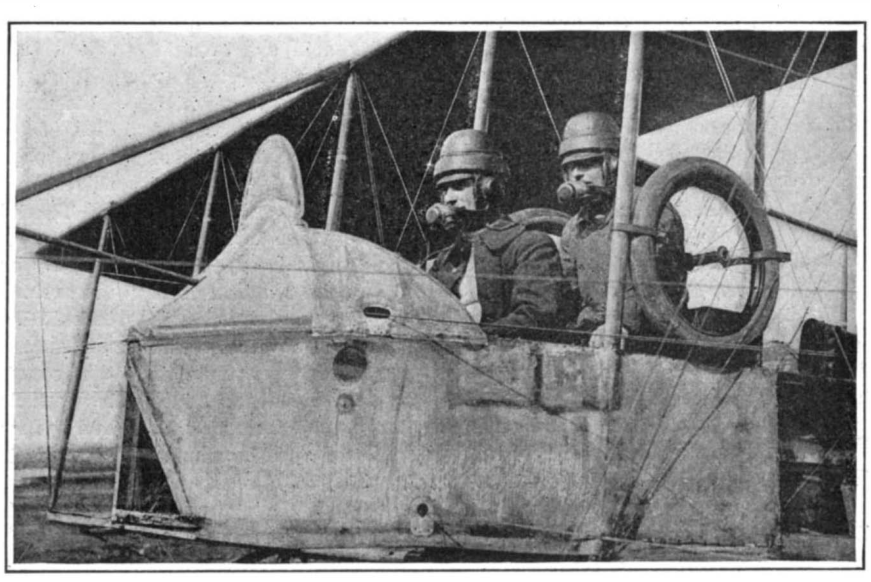
Bed, pillow, and blanket of straw.



The stretcher folded up.



A Dutch soldier in his bed of straw.



The roaring aeroplane motor makes telephone communication necessary.

## Manufacture of Optical Glass in America

THE glass used in this country for the manufacture of lenses is practically all imported except in the case of some of the smaller and cheaper lenses. For several years past the Bureau of Standards of the Department of Commerce has been endeavoring to persuade the glass manufacturers of the United States to take up the manufacture of this material, but they have been unable to do so, partly because of the limited quantity used as compared with other glass, but largely on account of the varying composition required and the difficulty of annealing the glass, as good optical glass must be entirely free from strain.

With a view to working out some of the underlying problems sufficiently to enable manufacturers to start in this matter, the Bureau secured two years ago an expert interested in the composition and testing of optical systems, and a little later secured another man skilled in the working of glass to the definite forms required by the theory. These steps were taken, first, partly because it is exceedingly difficult to find men having these qualifications, but principally because, as the work of experimental glass-making progresses, the glass must be put in the form of lenses and prisms to test; in other words, the Bureau had to be in a position to examine the product, as it was made experimentally. In July, 1914, a practical glass-maker was added to the force of the Bureau. He is a college graduate of scientific training, but skilled in the manipulation of furnaces, and is the sort of a man to make progress at the present stage of the work.

Small furnaces were built and melts of a few pounds of ordinary glass were made in order to become more familiar with the technical side. A larger furnace has just been completed, which will handle melts of 25 to 50 pounds. The Bureau is now making glass according to definite formulas, studying the methods of securing it free from bubbles, and other practical points. This is to be followed by an investigation of the method of annealing.

Several glass manufacturers have visited the Bureau already for suggestions as to equipment for the manufacture of optical glass.

## Mechanical Aids for Air Scouts

IN carrying out scouting observations with military aeroplanes it is essential that there be two men in the machine, namely, a pilot whose sole duty it is to operate and steer the craft, and an observer who can devote undivided attention to scanning the ground below him and making sketches of fortified works, the disposition of the enemy's guns, the movements of their troops, and the like. Unfortunately, the great noise made by the motor renders it impossible for the two men to carry on any conversation. Often this proves quite a drawback for a proper understanding between pilot and observer. To remedy this defect a loud-speaking telephone system is now in use between pilot and observer in some of the French military aeroplanes. As the accompanying photograph shows, each man is provided with a special helmet fitted with receivers over the ears and a transmitter located in convenient range of the mouth. This has proved to be a most practical way of keeping up a conversation in spite of the deafening noise of the motor.

A still further improvement is shown in our front page illustration. If the observer is to make sketches of the ground over which he is flying, he will be so much occupied, probably, as not to have time to jot down notes. Sometimes events may follow in such rapid sequence that he may not have time to write down all he would like to. In certain conditions of flight, it might be difficult to use pencil and paper. In order to remove all obstacles that might hamper the observer's work, a phonograph is now provided, with a speaking tube running to the observer's mouth, so that he may talk into the machine at any time during the flight and thus make a record of his observations, while at the same time his hands are free for the use of field glasses or the sketching pencil. At the end of the flight the phonograph delivers its message.

## The Search for Standard Weights and Measures of Length

THE use of melted quartz for the manufacture of standard measures of length has been a great disappointment, since even this material is subject to very marked fluctuations in length. The search for a suitable material is, however, being continued, because platinum-iridium, which has been used up to the present, is out of the question for practical purposes on account of its great cost. Dr. Guillaume discovered the alloy, which has become known under the name of "Invar," an abbreviation for "invariable." This nickel-steel alloy would make an ideal material for standards of length on account of its great resistance to changes in temperature, but unfortunately it is not proof against chemical action. For this reason it is suitable only for standards of the second grade, in which accuracy within a millionth part is sufficient. The ideal material, possessing the advantages of platinum-iridium, but less expensive than the latter, is therefore still to be found. Similarly good materials for standard weights have been sought extensively and various non-magnetic nickel alloys have been tested. Among these "Constantan" has proved to be inconstant, in spite of its name.

Another alloy, "Baros," has found considerable favor. It is produced by alloying ordinary nickel with a little chromium and manganese. Still more is expected of tungsten, on account of its hardness, its great density, and its durability. For the present tungsten is still too expensive, but very likely it will be obtainable at lower prices in the near future, since it is very much in demand. A review of the progress in the use of the metric system shows that during the last six years Denmark, Siam, Belgian-Congo and some of the Central American states have adopted this decimal system. The most important success still to be gained by the metric system, the conquest of England and of the United States, seems, however, still far removed, although Dr. Guillaume himself thinks that the difficulties in the way of its adoption by these countries are much exaggerated by his opponents.

# Doing Without Europe—IV

## How Industrial Research Will Help the Manufacturer Hitherto Dependent Upon Europe for Basic Materials

*It is the purpose of this article to show how industrial research can assist a manufacturer in devising processes for making the goods that he has been in the habit of importing from Europe and that he can no longer obtain because of the war. If the manufacturer will only realize that no matter how perfect his manufacturing processes may seem to him they are always capable of scientific improvement, he will succeed not only in making himself independent of Europe for the time being, but forever. He will enrich his country with a new industry and employ labor in new fields.*—EDITORS.

A FEW weeks ago we read in the newspapers that Thomas A. Edison, needing carbolic acid out of which to make phonograph records, and finding his source of supply cut off by the war, set to at once and started to make carbolic acid on his own account. In last week's SCIENTIFIC AMERICAN we cited the case of Mr. Maximilian Toch, who had to have barium, and who bought a deposit and an old plant in Tennessee and established what promises to be the first healthy American barium industry.

These are not isolated instances of manufacturers who have boldly started plants in this country and declared themselves industrially independent of Europe. There are about twenty-five gas mantle factories in the United States of America, all of whom are more or less dependent upon Germany for their stocks of the rare earth which is used to impregnate gas mantles. At least one firm, the Lindsay Light Company of Chicago, is now manufacturing its own thorium nitrate and cerium nitrate from Brazilian monazite sand, and has erected its own monazite refinery, gas being exclusively used in the process of extracting the thorium and cerium nitrate from the sand. In lithographing presswork leather rollers are almost entirely used for printing. This has always been the custom, since lithography requires both ink and water in handling the stone. A rubber roller acts as a repellent to the water and does not give satisfactory results; a leather roller absorbs a certain amount of the water and at the same time provides an excellent surface for distributing the ink. Before the war all the leather for making rollers was imported from Germany. German leather seems to be exceptionally smooth and soft. The leather in this country is tanned too quickly and the tanning method adopted leaves the leather in a harder condition. Since the outbreak of the war several firms have been making a study of the subject, and one firm at least is beginning to turn out almost as good a quality of skin as could be desired.

### Science May Prove the Salvation of Our Industries.

It so happens that the men who have tried to make here what formerly they imported from Europe are, for the most part, scientists or engineers. Mr. Edison, for example, is probably the greatest manufacturing inventor in the world. Mr. Toch is a chemist who is an authority on paints. The men at the head of the Lindsay Light Company are chemically trained. It is but natural that these men should be the first to strike out for themselves; for they knew that in industrial research, the very branch of knowledge with which they were most familiar, lay their salvation.

The lesson which they have been taught should be learned by every American manufacturer who has been dependent upon Europe. It is sad but true, that American manufacturing companies, as a whole, are indifferent to the possibilities of industrial research. We find them lavishing enormous sums on wonderful mechanical equipment and fancying that good machinery is the beginning and end of manufacturing efficiency. It may be that the war will dispel this illusion and that the American manufacturer will take something like a Teutonic interest in the chemical and physical side of his own business. Only our very largest corporations realize the absolute necessity of maintaining well-equipped research laboratories to improve old manufacturing processes and to devise new ones. The Chicago packing industry, the cottonseed oil industry, the electric lamp industry, the powder industry grew to enormous proportions, not only because of the millions and millions invested by financiers, but because of the industrial research which they conducted.

### What Research and Invention Did for Cotton.

Think, for example, what has been achieved by industrial research in converting the wastes of the cotton gin into a hundred different valuable edible products.

In 1872 only 52,000 tons of cottonseed were crushed. At the present time the average annual crush is over four million tons. In 1872 farmers received not over $8 per ton from the mills or $416,000 total, while to-day they are receiving $20 per ton for seed, with the result that the mills are paying to them over $80,000,000 annually.

This remarkable development in the cottonseed oil industry is due very largely to the work of the chemist. The early refining methods were crude. In 1900 the present system of refining was introduced, with the result that it is now possible to turn out perfectly neutral, odorless oils with such uniformity that cottonseed oil and its products must now be classed with granulated sugar.

What the chemist has done for the oil mills as a whole can be figured in dollars and cents as follows: The old method of working made 800 pounds of meal and left in it 10 per cent of oil or 80 pounds of oil per ton of feed. The present methods make 900 pounds of meal and leave 7 per cent of oil or 63 pounds, a difference of 17 pounds of oil saved per ton of seed worked. At 5 cents per pound, this means a saving of 85 cents per ton of seed, or $3,400,000 on the crop.

If we compare the old refining methods with the new, we find, instead of 12 per cent loss, an average of 8 per cent; 4 per cent of 3,200,000 barrels worth 5 cents per pound, $20 per barrel, or $2,560,000.

### Converting Cheap Oils into Profitable Fats.

Perhaps the most marvelous aspect of the research which has taught us how to extract from cottonseed marketable products is that which is based upon the discovery of two French chemists, Sabatier and Senderens. These two Frenchmen discovered that unsaturated fatty acids or their glycerides can be converted into saturated compounds. Stated less technically, they discovered a way of converting oils and soft fats into hard fats. Cottonseed oil costs about 4 cents a pound; by a modification of this process introduced by the French chemists it is converted into an excellent substitute for lard, which sells at 16½ cents a pound. The cost of the transformation varies from ½ to 1 cent a pound.

To understand how this is effected, we must understand what a fatty acid is. Chemically a fatty acid may be described as a body compounded of carbon, hydrogen, and oxygen. A glyceride is a fatty acid containing glycerine and having the same compounds, namely, carbon, hydrogen, and oxygen. The difference between a saturated fatty acid and an unsaturated fatty acid is the difference between a fluid and a solid. Glycerine to-day sells at 18 cents a pound, and corn oil or cottonseed oil at about 6½ cents a pound. By using this process 100 pounds of corn oil can be made to yield 12 pounds of good glycerine. Similarly the conversion of soap stock into fatty acid and glycerine has raised the value of the fat therein at least 3 cents per pound or $12 per barrel. In refining 3,200,000 barrels of oil, 7 per cent would appear as fatty acid in soap stock, 224 pounds of which at $12 per barrel would be $2,688,000. By making the oil edible, $2.50 per barrel is a conservative figure to put on the increased value of the oil on 3,200,000 barrels. This amounts to $8,000,000 a year.

### A Miracle Wrought by Hydrogen Gas.

And how is this marvelous result attained? Merely by means of hydrogen gas. It appears that in the presence of or in contact with certain metals, chemical bodies undergo changes which do not otherwise take place. The reactions induced by the presence of what is known as a catalyst involve merely the splitting up of a single chemical body, of which the decomposition of acetylene in the presence of finely divided nickel is an instance, or the combination of two chemical bodies which, but for contact with the catalyst, would have retained their compositon unchanged, although in contact with one another. The hydrogenation of a fatty acid, where hydrogen and the fatty acid are brought into contact in the presence of a suitable catalyst, is an instance of the latter kind of reactions, and that which forms the basis of most of the industrial processes here outlined. The catalyst is a metal such as fine nickel powder.

At least seven companies are busily engaged in thus converting soft fats and oil of small value into edible hard fats of great value. But the process is capable of much extension. We find that industrial research is now being conducted by the very large companies to harden other oils besides those extracted from corn and cotton. When tallow drops very low, for example, it might not always be profitable to convert a soft fat into tallow. It has occurred to one large manufacturer that perhaps fish oil might be thus hardened and the market steadied. Fish oil will always be cheap. A process has now been devised which will enable that company to hydrogenate fish oil and to convert it, for instance, into a soap quite free from all fishy odor.

Naturally research of this kind can be conducted only at enormous expense in a finely equipped laboratory. But the small manufacturer can easily improve his own manufacturing processes or even start to employ processes specially created for him by employing outside chemists. Columbia University, the University of Pittsburgh, the University of Illinois, the Massachusetts Institute of Technology; in a word, most of our foremost universities, technical schools, not to mention dozens of privately practising chemists, will be glad to help him at a cost ridiculously low compared with the results that may be expected. Already the thirty-nine men in the Mellon Institute of the University of Pittsburgh are in part employed in solving the industrial problems which have suddenly arisen because of the war.

### Opportunities Created by the War.

We heard so much of the coal tar chemical industry at the outbreak of the war, of the difficulties with which textile manufacturers in particular were confronted because of the shortage of coal tar dyes, that the full industrial effect of the European conflict is even yet not fully realized. In the preparation of this article it was deemed advisable to obtain firsthand information which would show just what American industries had been most injured by the cessation of importations. Accordingly, the author passed several days in the United States Appraisers' Office in order to obtain a general survey of the situation.

All the chemical industries have been hard hit—not the users of coal tar chemicals alone. Since carbolic acid, for example, is extensively used in antiseptic dressings, England, the chief source of supply, has placed an embargo upon its exportation. A similar embargo has been laid upon mercurial preparations. The importation of oxalic acid, phosphoric acid, crude vegetable drugs, chemical salts and compounds, lime chloride, potash and potash compounds, and nitrates has suffered. Perhaps the industries which are dependent upon European potash are most profoundly affected, mainly because the chief source of potash is Stassfurt, Germany. A complete list of the articles which we need most follows:

### Importations Which Have Decreased in Quantity Since the Outbreak of the War.

Gross almerode glasspot clay, fuller's earth, carbolic acid, phosphoric acid, calomel, chemical salts and compounds, crude drugs (most of the organic drugs come from Hungary), coal tar medicinal preparations, mercurial preparations, mineral salts, magnesia (loose), anilin salts and oil, coal tar colors and dyes and drugs, alizarin dyes, fusible enamels in canes, etc., madder, Paris green and London purple, red lead, sumac extract (used in the silk industry), mesothorium, lime chloride, cadmium (for colors), phosphorus, potash and potash compounds, camel's hair (for brushes, etc.), deer skins, mohair, wool waste and rags, wool yarns (embargo by England), lentils (grown chiefly in eastern Prussia), potato flour, grain alcohol, alcoholic beverages, beer, fruit syrups (prune juice), German wines, mineral waters, chemical glassware and mortars, scientific instruments, crucibles, glass strips, lenses, silica ware, spectacles, eyeglasses and goggles, X-rays tubes, musical instruments, horsehair (artificial), felts (wool and hair, machine and piano), blankets, press cloths for oil presses, camel's hair cloths for oil presses, billiard cloth, broadcloths (German), German wools and worsted, imitation pearls, beads, burlap for bags, glassware, precious stones, enameled ware, metal clippings for brass powder, thermos bottles and parts, aluminium flatware, carbons for electrical use, electrical instruments, gas mantles, baskets, catgut, firearms, hat wire, needles, pins, aluminium (exportation prohibited), antimony (exportation prohibited), ball bearings, ferromanganese, cylinders for gas containers, nickel and nickel alloys, asbestos (manufactured), magnesite (Hungary), lithograph stones (not engraved), dental instruments, surgical instruments, pearl for knife handles, engravers' plates and dies, roofing felts, vegetable ivory, paper, bronze powder, tin powder, nitrates (fertilizers).

### The Difference in Cost Between American and European Labor.

Every one of these articles is a subject for industrial research. Given an abundance of raw materials and technical skill, and there is no reason why we should not succeed in establishing the needed industries in this country. But what about the difference in cost between American and European labor? Cheaper fuels and the raw materials ought to offset cheaper European labor costs in many industries. It cannot be denied, however, that a protective tariff of some kind will be required for some industries, as we pointed out in previous articles; also an anti-dumping law which would prevent a German trust, despite an American tariff, from deliberately selling below our lowest possible cost of manufacture.

# The Government Ship Purchase Bill—I

## A Defense of the Administration's Policy

### By Judge Joshua W. Alexander, Chairman of the House Committee on Merchant Marine and Fisheries

*This comprehensive, concise, and forceful article, defining the course of action of the Administration in its efforts to meet the existing emergency in our merchant marine, has been written at the request of the Editor by Representative Joshua W. Alexander, who introduced the shipping bill which has produced the present deadlock in Congress and has become the subject of bitter controversy throughout the country.*

*The case of the opponents of the bill will be presented in a future issue.*—EDITOR.

DURING the fiscal year 1914 the foreign commerce of the United States amounted to four and a quarter billion dollars. The imports were nearly two billions of dollars and the exports over two and one-third billions of dollars. Not more than 10 per cent of this commerce was carried in vessels flying the American flag. It is estimated that foreign ship owners collect from the American people 250 to 300 millions of dollars a year for the ocean transportation of passengers and cargoes to and from the United States. This sum materially affects our trade balance. Just prior to the European war we had ships of only 1,376,809 tons gross in the foreign trade. It is estimated that soon after war was declared 5,500,000 tons of foreign shipping was withdrawn from the ocean carrying trade; and that 550,000 tons of German and Austrian shipping is interned in American ports.

The war in Europe had hardly begun when the American people became keenly sensible of the imperative need for an American merchant marine. England, France, and Germany, our principal carriers, were at war, and we needed vessels clothed with the rights of neutrals to carry our overseas commerce. The Ship Registry Act admitting foreign built ships to American registry for the foreign trade, and suspending temporarily the provisions of our navigation laws requiring the captains and watch officers on vessels of the United States to be American citizens, was passed August 18th, 1914.

The Administration was assured that the passage of this act would bring a large measure of relief.

No sooner was it passed, however, than the same interests called the attention of the Administration to the fact that Great Britain, France, and Germany were writing war risk insurance on vessels and cargoes under their flags, and unless our Government would do likewise the Ship Registry Act would not be much help. An act was promptly passed by Congress and approved by the President creating a War Risk Board in the Treasury Department and the Government has since written millions of dollars of war risk insurance on vessels under our flag. No serious objection was urged to this legislation upon the ground that the Government should not engage in the insurance business. The emergency had to be met and private companies were impotent. This measure was urged by the people who now object to the Government ship purchase bill and denounce it as paternalism and State socialism. They were to be the beneficiaries if the Government engaged in the insurance business. All the people will be the beneficiaries if the latter bill becomes a law.

After the Ship Registry Act and the act creating the War Risk Board were passed, it was represented to the Administration and to the committees in Congress having jurisdiction of the subject matter that on account of the disturbed financial conditions growing out of the war in Europe it was impossible for private persons, firms, and corporations to purchase foreign tonnage and bring it under the American flag, unless the Government would guarantee their bonds or lend them money, or in some other manner give them aid. This was the situation when I introduced the ship purchase bill.

With our foreign commerce paralyzed and our utter dependence on the shipping of Great Britain for service and her interests sharply antagonistic to our own, with ocean freight rates mounting higher and higher every day and facilities under our own flag distressingly inadequate, it was thought by those charged with responsibility in the premises, that if the Government must carry all these burdens in the interest of private shipping and give private shipping a free hand to exploit our commerce and charge all the traffic would bear, it would be wiser to provide by law for a Government owned and controlled merchant marine operated in the interest of the agricultural, manufacturing, and commercial interests of the United States, and give that service at reasonable rates and at the same time compel other lines to do likewise. And right here is the rub. There is no reason to believe that the Government will enter into competition with the established lines where they are giving the people good service and at reasonable rates. It would be folly to do so.

What are the fundamental proposals in the ship purchase bill now pending in Congress, which the shipping interests are opposing so violently?

The bill provides that the United States, acting through a shipping board, may subscribe to the capital stock of any corporation or corporations now or hereafter organized under the laws of the United States or of any State or of the District of Columbia, the object of such corporation to be the purchase or construction, equipment, maintenance, and operation of merchant vessels in the trade between the Atlantic, Gulf, or Pacific ports of the United States and the ports of Central and South America and elsewhere to meet the demands of the foreign commerce of the United States, or to charter vessels for such purposes and to make charters or leases of any vessel or vessels owned by such corporation to any other corporation, firm, or any individual to be used for such purposes, subject to the approval of the shipping board.

The initial stock of the corporation shall not be over $10,000,000, the shares of the par value of $100. The capital stock may be increased by the shipping board with the approval of the President. The United States shall subscribe for 51 per cent of the stock and each increase. The remainder may be subscribed for by the public, or by the United States if not subscribed for by the public. The United States, through the shipping board, with the approval of the President, is authorized to purchase or construct vessels; to transfer them to such corporation; and to pay for same by issue of Panama Canal bonds. Such corporations shall make provision for sinking fund and for depreciation charges, under the rules and regulations to be prescribed by the shipping board. The vessels purchased or constructed under the act shall be entitled to registry under the laws of the United States, but may engage only in trade with foreign countries or with the Philippine Islands, Hawaiian Islands, Porto Rico, and the islands of Guam and Tutuila.

The Secretary of the Treasury, the Secretary of Commerce, and three additional members, two of whom shall have practical experience in the operation of vessels in the foreign trade, subject to the direction of the President, constitute the shipping board, and are vested with power to vote the stock of the United States in such corporation and to do all other things necessary to protect the United States and to carry out the purpose of the act, and with the approval of Congress may sell the stock of the United States in such corporation.

The President is given the power to charter naval auxiliaries and vessels belonging to the War Department suitable for commercial uses and not required for naval or military purposes in times of peace, and vessels owned and operated by the Panama Railroad Company to the corporation created by the act, the vessels purchased or constructed to be of a type, so far as our foreign trade may permit, suitable for naval auxiliaries. The President is authorized to take them over for use as naval auxiliaries or for other purposes, and at a reasonable price of rental.

Powerful private interests are arrayed against this bill. The representatives of special privilege and the powerful organization known as the shipping trust, with its affiliations in the domestic and foreign trade, oppose it. They are vociferous in the expression of their fears that the passage of the bill will involve us in grave complications with the belligerents. They may be counted on to promote legislation when it is for their benefit and will increase their profits, but view with grave concern legislation for the general welfare. Another class opposes Government ownership, honestly believing it is not a proper function of the Government. The first class also takes advantages of the reasons urged by the latter to defeat this legislation. None of these classes has proposed a rational plan as a substitue for the Administration bill.

It is assumed that Government ownership is something new under the sun. Those who urge this objection assume that the American people are ignorant of the many activities of the Government in which the principle is applied. Private enterprise failed to build the Panama Canal, and the Government took over that great enterprise and has completed the canal in the interest of the world's commerce, and for the national defense. The Government owns and operates the Panama Railroad. It was relocated and rebuilt within the last five years at a cost of about ten millions of dollars; also owns and operates the Panama Railroad Steamship Company's fleet of passenger and freight steamers from New York to Panama, and has done so for eleven years past. The average rate of freight between New York and the Canal Zone at the time the Government took over the operation of the line was $8 per ton. This has been gradually reduced to the present rate of $3.50 per ton on rough goods and $4.50 per ton for general cargoes. The reductions made by the Government line similarly affected the rates by the other lines, all of which were of foreign registry. The result has been an immense saving to the Government in cost of construction of the canal, at the same time no complaint has been made that the reduced rates have not been remunerative to the foreign as well as the Government line.

The War Risk Insurance Bureau is a Government activity that has worked well. The rates are one eighth of one per cent. What they would be if the business was being done by private companies must be left to our imagination. The Government has a splendid fleet of vessels in the revenue cutter service under control of the Treasury Department. The successful and economic management of this fleet requires as high, if not higher order of skill and efficiency than is required in the management of a fleet of merchant vessels.

The Government, through the Post Office Department, has taken over a large part of the transportation business heretofore done by the express companies, and at a reduction of cost to the American people of about 50 per cent, and little heed would be paid to a demand to abolish the parcels post upon the ground that the Government should not engage in the transportation business.

The Government is building a railroad in Alaska at a cost of forty millions of dollars to unlock the mineral wealth of that great storehouse of nature for the benefit of all the people rather than have it exploited for the benefit of the few. It is to be hoped if the Government goes into the steamship business it will prove a greater success than has the operation of our railroads under private control, notably the New Haven under the Mellen *régime*.

The Government owns the greatest wireless system in the world, under the control of the Navy Department, which not only renders efficient service for all the departments of the Government, but does a large amount of commercial business at reasonable rates, and could do more without additional expense of operation. Yet it is assumed that the Government should not engage in the ownership and operation of shipping in the foreign trade to meet the demands of our growing and expanding foreign commerce, although private capital has failed for fifty years to provide such service for the American people.

The Washington *Post* of February 7th in an editorial very pertinently remarks: "Private capital knows full well that it can not and will not establish an American merchant marine without the aid of public cash contributed in some way, form, or manner by the Government. It is to the interests of foreign shipping combines that no American merchant marine be established. It is to the financial interests of powerful representatives in the country of foreign shipping—commercial and financial interests—that no American merchant marine be established unless they can control it, save their European allies from American competition, and make such rates for freight and passengers as will afford them large profits. They are entirely willing to draw financial aid from our Government if the control of the marine is given them."

Up to the European war our foreign commerce was in the grip of foreign shipping lines. These lines were controlled by shipping rings and competition for the most part had been eliminated. Rates had increased in the last few years 50 to 200 per cent. These combinations were so powerful in all the trade areas of the world that no independent ship lines dared to enter the field and compete with them.

**Summary of the Most Striking Increases.**

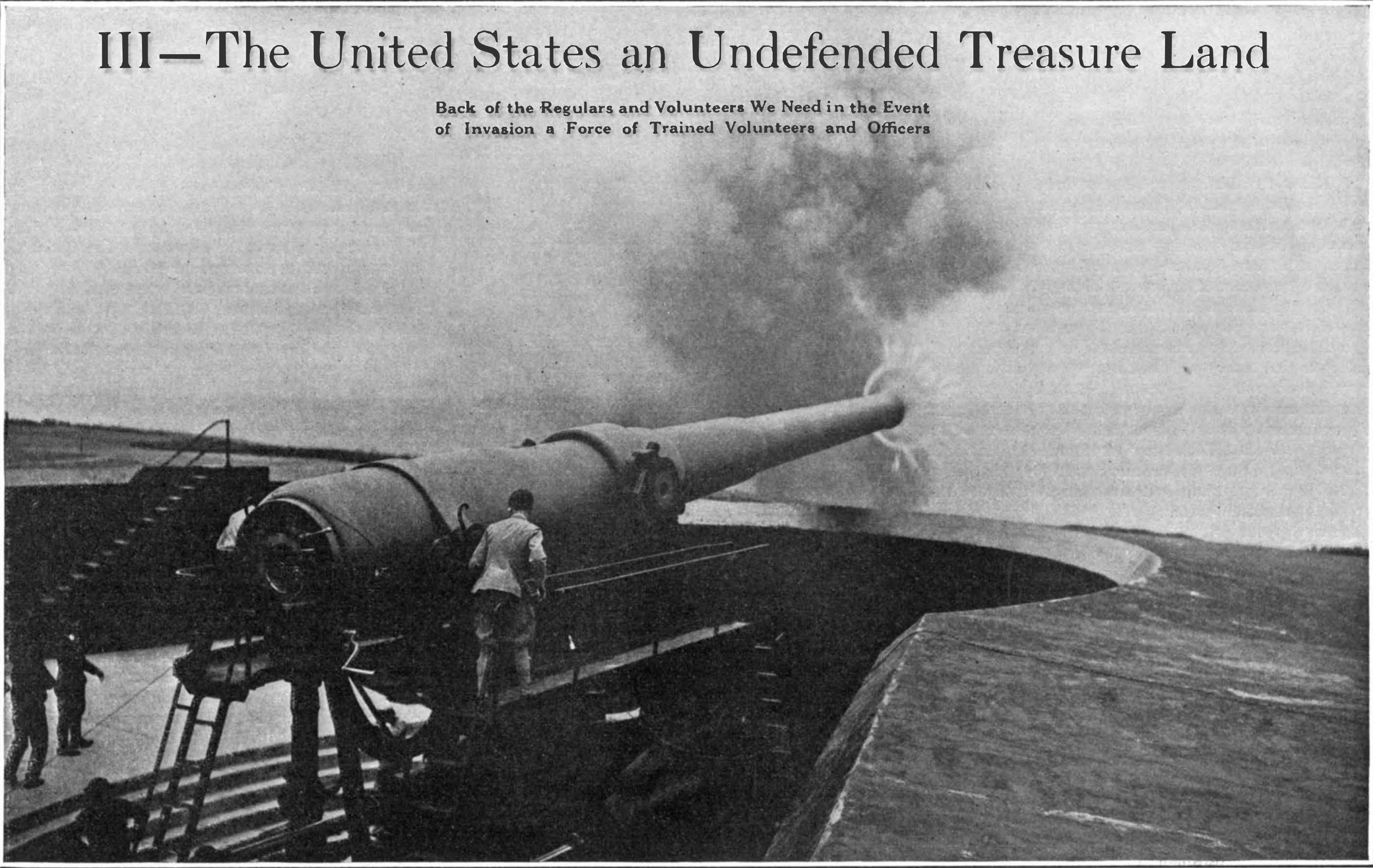
Since the outbreak of the war in Europe the following are striking illustrations of ocean freight rates:

Ocean freight rates on grain from New York to Rotterdam have been increased since the outbreak of the war 900 per cent; on flour, 500 per cent; on cotton, 700 per cent. From New York to Liverpool the rates on the same commodities have increased from 300 to 500 per

(*Concluded on page 185.*)

# III—The United States an Undefended Treasure Land

Back of the Regulars and Volunteers We Need in the Event of Invasion a Force of Trained Volunteers and Officers



**Discharge of a coast-defense 12-inch gun. Note flash of white-hot gas at the muzzle.**

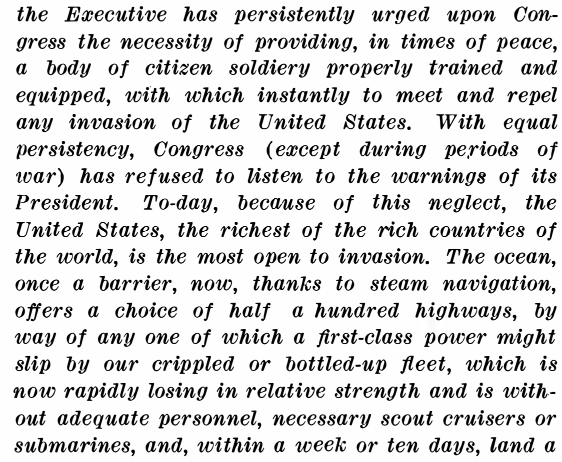
*From President Washington to President Wilson, the Executive has persistently urged upon Congress the necessity of providing, in times of peace, a body of citizen soldiery properly trained and equipped, with which instantly to meet and repel any invasion of the United States. With equal persistency, Congress (except during periods of war) has refused to listen to the warnings of its President. To-day, because of this neglect, the United States, the richest of the rich countries of the world, is the most open to invasion. The ocean, once a barrier, now, thanks to steam navigation, offers a choice of half a hundred highways, by way of any one of which a first-class power might slip by our crippled or bottled-up fleet, which is now rapidly losing in relative strength and is without adequate personnel, necessary scout cruisers or submarines, and, within a week or ten days, land a fully equipped advance force of 200,000 highly-trained troops. To oppose this, the United States, in thirty days, could concentrate, at the most, 30,000 regulars and 60,000 militia.*

*The present series of articles is published with a view to bringing before the country at large and Congress in particular the true facts as regards the military defenselessness of the United States. The facts, as here given, are in the highest degree authoritative. They represent the alarming conditions and the remedy therefor, as presented, for many years past, in the annual reports made to the various Secretaries of War by the General Staff of the Army. What is Congress going to do about it?*
—Editor.

IN addition to the reserve behind the regular army and militia, we must take up the question of building up a large force of volunteers, because, as already stated, the regular army and militia at war strength will furnish only about one third of the force which will be needed in case of war with a first-class power. No adequate measures have ever been taken to train or organize officers or men for volunteers. It is believed this can be done for the men and in part for the officers through a special form of enlistment, which will interfere as little as possible with the educational and industrial careers of those affected; and it has been suggested that training adequate in character could be secured through three annual periods of two months each. The men under training will be in camp for two months each summer for three years, and subject to an intensive training under the most carefully selected regular officers. Men completing the three periods should be held as volunteer reservists for a period of years, dependent upon the size of the class coming to training each year. All this sounds large and formidable, but it must be done if we are to be ready to meet the emergency which may be thrust upon us at any time. Even if we are unable to train a sufficient number of men for enlisted men of the volunteers, we must, in time of peace, train the necessary officers. This is absolutely essential, for it must be remembered that there will be no time to develop officers for volunteers; in fact, no means of developing them, once war is upon us. All regular and militia organizations and officers will be in the field and the training of volunteers will be conducted under conditions which make it almost impossible to train them. Thousands of officers must be trained in advance if the volunteers are to be even reasonably efficient in the early stages of the war.

During the period of their active service the officers and men must be enrolled in properly organized military units. They must be mobilized each year and their arms and equipment held at all times ready for immediate use. The number of volunteer troops which will be necessary to provide the required force, 460,000 mobile troops, including the regulars and the militia at war strength, will be about 135,000.

In addition to this force of volunteers it must be remembered that the General Staff in its plan of defense, as set forth in the Organization of the Land Forces, has recommended as necessary that 300,000 additional volunteers be at once raised. When it is remembered that the coastguard troops (that is to say, troops which will co-operate with the coast fortifications and without which the latter will be open to capture by land attack made by raiding parties from fleets) amount to nearly 400,000 for both coasts, about 275,000 for the Atlantic and Gulf seaboard, it will be seen that steps must be taken to provide the necessary officers and men for this force. Any increase which may be made in either the regular or militia establishment by adding new organizations will reduce by just so much the number of volunteers to be raised in the early stages of a war.



**Engineer's intrenching outfit, packed on mule.**

Any assumption that hundreds of thousands of volunteers are going to spring to arms in a condition of efficiency is most dangerous and wholly unjustified; in fact, such a responce would be literally impossible, and any dependence upon it is wholly unwarranted. This fact cannot be too strongly impressed upon the American people.

Above all else in importance in raising and organizing volunteers is the provision of an adequate number of officers—officers who are efficient and well trained. These we must provide in time of peace, even if we are unable to provide the enlisted force, that is to say, the men. Our plans for the mobilization and utilization of this volunteer force, the points of mobilization and area in which it is to operate, must all be worked out in great detail in time of peace, for any war in which we are engaged would probably be one of aggression on the part of our enemies, consequently the attack will come suddenly and at a time when the enemy is fully prepared. Knowing his own plans, he will bring against us the most thoroughly trained and equipped military organizations, fully prepared in every detail to attain his objective. To assume that equally good men, but untrained and without the necessary equipment and trained officers to lead them, would have any chance for success, is folly. Such an attitude on our part can only result in disasters and in the useless and unnecessary wasting of the lives of our people.

### The Present Sources of Officers for Volunteers.

The present sources of officers for volunteers are the following: First, men who have had service in the regular army or militia and are still of an age fit to bear arms. Second, men who have graduated from military schools maintaining a course in military instruction under regular army officers. Third, approved graduates from the military instruction camps for college students. Fourth, men who have qualified for appointment as officers of volunteers through examination. All of these sources at present, with the exception of the graduates of the military schools, are limited.

### Summer Camp Training of Officers.

It is hoped to greatly increase the number who will be available through training at the summer camps for college men. Last year there were about seven hundred students at these camps, and their record of performance was so excellent that there is every reason to believe these camps will be a most valuable source of supply for volunteer officers. In the first place, the men who attend these camps go because they are interested. This is shown by the fact that they pay their own ex-

penses. They receive five weeks of intensive training, during which they get about as many hours of actual work as the average militiaman does during an average enlistment.

**In Case of Invasion We Should Require 30,000 Volunteer Officers. Major-General Wood's Plan.**

The magnitude of the task in training volunteer officers is apparent when it is realized that it will be necessary to develop not less than 25,000 in case we should have to mobilize enough additional volunteers to bring our total force up to 1,000,000 men. It has been recommended by Major-General Wood for a number of years that five hundred selected graduates of colleges maintaining military instruction under officers of the army be appointed provisional second lieutenants for one year and that they receive full pay and allowance of a second lieutenant, amounting to about $1,750 in money and valued at approximately $500 in allowances, each young man to be appointed subject only to physical examination, as they will be graduates of institutions of high standing. This number should be increased to 1,000. This procedure if adopted will give us a thoroughly well trained reserve officer, a man who has had from two to four years of military training at a college or technical school under the direction of an officer of the army, plus one year of actual service in the regular army. As the line of the regular army is always short about seven hundred to eight hundred officers, incident to detached service of various kinds, and this without in any way fully meeting the demands upon it for officers, it will be seen that these young officers will be of real value during their year of service. The cost to the Government will be comparatively little. The young men themselves will be able to leave the service with from $600 to $800 and should be held as reserve officers for from eight to ten years with the understanding that they will be called to duty only in case of war and for brief periods of training a few days each year. This would give us a steady annual increment of well-trained reserve officers, and these, taken in connection with the men who are qualified at the summer camps and through special means of examination, would eventually give us a reasonable reserve of officers for volunteers.

**During Civil War Congress Made Land Grants to Encourage Military Training in State Colleges.**

In the early days of the Civil War, Congress passed an Act, known as the Morell Act, which made grants of public lands to various State colleges, known as agricultural and mechanical colleges, and provided that military instructions would be maintained at these colleges. These grants have been of great value to the colleges, and some of them have maintained a rather effective course in military instruction. Others have simply kept up a nominal amount of work. The instruction at all these colleges should be standardized, so that the Government may know exactly the qualifications, so far as military knowledge goes, of the graduates, and an attempt should be made to secure legislation which will hold those graduates who have demonstrated fitness through practical work for a number of years as reserve officers and non-commissioned officers. This is not unreasonable in view of the educational facilities and advantages extended to the students at these institutions. A return in the form of service for six to eight years as volunteer reserve officers would seem but just and equitable.

**The Early Presidents, Beginning With General Washington, Strongly Advocated Peace-time Preparation for War.**

The necessity for the preparation for possible war was recognized by the early Presidents in various messages, but, little by little, interest in the subject of preparedness seems to have disappeared.

Thus, from Washington's first annual address we quote the following:

"Among the many interesting objects which will engage your attention, that of providing for the common defense will merit particular regard. To be prepared for war is one of the most effectual means of preserving peace. A free people ought not only to be armed, but disciplined; to which end a uniform and well-digested plan is requisite; and their safety and interest require that they should promote such manufactures as tend to render them independent of others for essential, particularly military supplies."

From his third annual message (speaking of the militia):

"This is certainly an object of primary importance, whether viewed in reference to the national security, to the satisfaction of the community, or to the preservation of order. In connection with this the establishment of competent magazines and arsenals and the fortification of such places as are peculiarly important and valuable naturally present themselves to consideration. The safety of the United States, under divine protection, ought to rest on the basis of systematic and solid arrangements exposed as little as possible to the hazards of fortuitous circumstances."

Soldiers at meal, Fort Crockett, Galveston, Texas.

From his fifth annual address:

"I cannot recommend to your notice measures for the fulfillment of our duties to the rest of the world without again pressing upon you the necessity of placing ourselves in a condition of complete defense and of exacting from them the fulfillment of their duties toward us. The United States ought not to indulge a persuasion that, contrary to the order of human events, they will forever keep at a distance those painful appeals to arms with which the history of every other nation abounds. There is a rank due to the United States among nations which will be withheld if not absolutely lost by the reputation of weakness. If we desire to avoid insult we must be able to repel it; if we desire to secure peace, one of the most powerful instruments of our rising prosperity, it must be known that we are at all times ready for war."

From his eighth annual address, speaking of the country's inability to protect its foreign commerce:

"Will it not then be advisable to begin without delay to provide and lay up materials for the building and equipping of ships of war and to proceed in the work by degrees in proportion as our resources shall render it practicable without inconvenience, so that a future war of Europe may not find our commerce in the same unprotected state in which it was found during the present."

**John Adams Said: "An Efficient Preparation for War Can Alone Secure Peace."**

From John Adams's special message:

"With a view and as a measure which even in time of universal peace ought not to be neglected, I recommend to your consideration a revision of the laws for organizing, arming, and disciplining the militia, to render that natural and safe defense of the country efficacious."

From his second annual message (message dealing with the relations with France):

"But in demonstrating by our conduct that we do not fear war in the necessary protection of our rights and honor, we should give no room to infer that we abandon the desire of peace. An efficient preparation for war can alone secure peace. . . .

"We ought, without loss of time, to lay the foundations for that increase of our navy to a size sufficient to guard our coasts and protect our trade."

**Thomas Jefferson Advocated Compulsory Service.**

Jefferson in his fifth annual message advocated:

"The organization of 300,000 able-bodied men between the ages of 18 and 26 for offense or defense at any time or at any place where they may be wanted."

In a letter to Monroe he advocated compulsory service.

"We must train and classify the whole of our male citizens," he said, "and make military instruction a part of collegiate education. We can never be safe until this is done."

From his eighth annual message:

"If war be forced upon us in spite of our long and vain appeals to the justice of nations, rapid and vigorous movement at the outset will go far toward securing us in its course and issue, and toward throwing its burdens on those who render necessary the respect from reason to force. . . .

"Considering the conditions of the times in which we live, our attention should unremittingly be fixed on the safety of our country. For a people who are free and who mean to remain so, a well organized and armed militia is their best security."

**President Wilson on the Need for the War-training of Our Citizens.**

"It will be right enough, right American policy, based upon our accustomed principles and practises, to provide a system by which every citizen who will volunteer for the training may be made familiar with the use of modern arms, the rudiments of drill and maneuver, and the maintenance and sanitation of camps.

"We should encourage such training and make it a means of discipline which our young men will learn to value. It is right that we should provide it not only, but that we should make it as attractive as possible, and so induce our young men to undergo it at such times as they can demand a little freedom and can seek the physical development they need, for mere health's sake, if for nothing more."

## Small Leaks

WE are often admonished to take care of small leaks—to keep faucets tight because the loss incident to a small leak runs up into a considerable sum.

Now, it may be of interest to know just what the water loss would be from a leaking faucet. Let us assume that a faucet leaks to the extent of allowing the escape of two drops of water per second. In one month the leakage would amount to a little over 84 gallons. With water at 25 cents a thousand gallons, the money loss per month would be about 2 cents. Should the leak be in a hot-water faucet, the loss would be greatly increased because of the fuel required to heat the water. With coal at $5 a ton, burned with the efficiency usually attainable under domestic conditions, the loss in water and heat in the above example would be nearly 10 cents a month.

The fact that the loss is small should not allow us to neglect small leaks, because, by disregarding them we tend to become slovenly in all things. Furthermore, small leaks do not remain small. The constant leakage of faucets wears small passages through the seats and makes tightness impossible. The next thing then is a new faucet with the accompanying plumber's bill, which is notoriously not small.

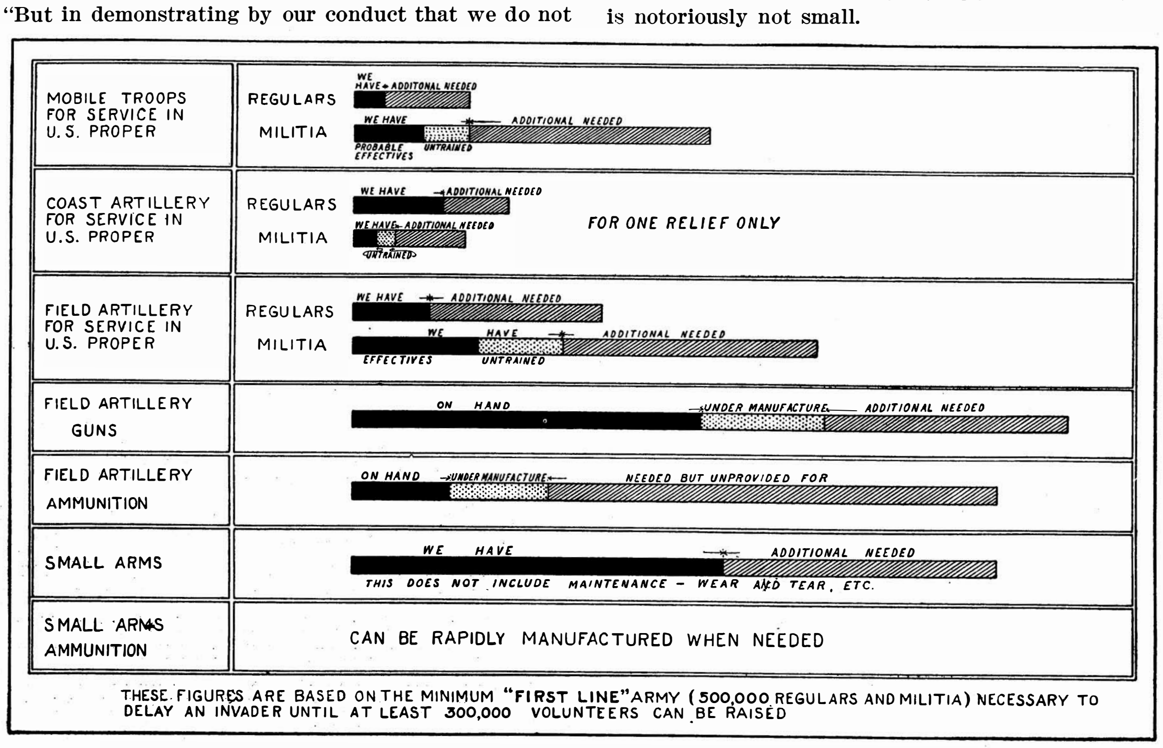
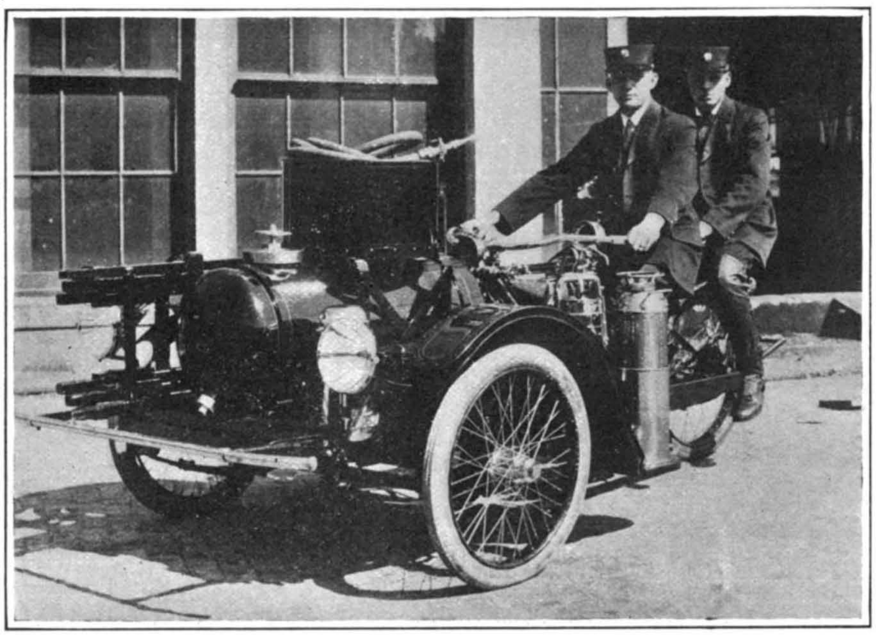



Diagram showing the alarming condition of our military defenses.

## Chemical Engine on the Tri-car

A THREE-WHEELED fire engine of light weight, low cost, and high efficiency has been developed recently. It is good for a speed of 45 miles an hour, carrying two firemen and a complete chemical equipment, a reel of hose, a 12-foot ladder and all that is required for subduing a blaze before it has made a disastrous start. In short, it is a light scout car in the never-ending warfare against fire, which may be used as an auxiliary to the heavier and more costly fire apparatus. It is also serviceable in small, but scattered communities, which cannot afford the larger engines. Its low cost, small size (making an expensive fire house unnecessary), and its small upkeep charges adapt it particularly for a small village.



A motorcycle chemical engine.

## Who Will Rescue the Lost Explorers?

AT this moment it is probable that three, and possible that eleven, of the men who constituted the Canadian Arctic Expedition of 1913 are spending the sunless days of the polar winter under conditions of peculiar hardship, hoping against hope that the still distant summer will bring them salvation. Up to the present time it is doubtful whether the rest of mankind will make any serious effort to realize this hope.

It will be recalled that when the "Karluk" was crushed in the ice north of Siberia her crew became divided into three parties. One party, comprising four men, under First Officer Anderson, left the scene of the shipwreck January 21st, 1914, well equipped and provisioned for three months, headed for Herald Island, which had been mistaken for Wrangel Island. A supporting party left them a few days later, halted by open water some three miles from this land, since which time they have never been heard from. Whether they succeeded in reaching Herald Island or were carried by drifting ice to some other part of the Arctic Ocean is unknown. On February 7th four more men, viz., Dr. Forbes Mackay, the surgeon; James Murray, the oceanographer; Henri Beuchat, the anthropologist; and Seaman Morris, also equipped with sledges, food, and ammunition, left the main party in an effort to reach land. Their fate remains equally problematical. The rest of the crew ultimately reached Wrangel Island, where three of them died and the remainder, except Capt. Bartlett and an Eskimo companion, who pushed on to the continent, survived until a relief expedition reached them last September.

Meanwhile, in another part of the Arctic Basin, the leader of the expedition, Stefánsson, embarked upon a perilous sledging expedition over the sea ice from Martin Point, Alaska, in the hope of reaching unknown lands to the north. On April 6th, 1914, a supporting party left him with two companions, Storkersen and O. Anderson, a sledge, six dogs, and a good supply of food and ammunition, at the edge of the Continental Shelf. He then hoped to return in a few weeks to Alaska or to gain the shores of Banks Land. It is nearly certain, however, that he was carried westward on the drifting ice, and, if he is still alive, he is now probably somewhere north of Siberia. He is an experienced and resourceful Arctic traveler, and was not at least in much danger of starvation, as game was abundant.

It is an unprecedented situation in the history of polar exploration that no plans for seeking these lost explorers have, as yet, definitely materialized. The "Karluk" survivors on Wrangel Island were rescued last season by one of the three ships, all flying the American flag, which went in search of them. No relief expedition was sent out by the Canadian government. Neither is there any movement on foot in Canada to rescue Stefánsson and his two companions, or to undertake the admittedly less promising quest of the eight men last heard from near Herald Island. The most hopeful feature of the situation that has yet developed is the recent project of the Aero Club of America to utilize aeroplanes, in conjunction with a suitable steamer, for the dual purpose of seeking the lost explorers and clearing up some of the mysteries of Arctic geography. It ought not to be difficult to raise the relatively small sum needed for this humane and scientific undertaking.

---

**A Model Testing Laboratory.**—The new testing laboratory of the Pennsylvania Railroad, at Altoona, is, as might be expected, a model plant, and there is at least one novelty in the construction of the building, apart from the outfit, that will be watched with interest. The floors are an experiment, having been constructed on a new plan which is said to have originated in Greece. On a five-inch layer of sawdust is placed a half inch layer of a special cement, and this construction is expected not only to deaden sound, but to be easier and more comfortable for the workers who have to stand for long periods. Among the apparatus installed is a machine capable of exerting a pressure of one million pounds, which can also be used for testing couplers and heavy material. There are also machines for testing brakes, steel bars and many other forms and classes of material. There is also a well-equipped electrical testing department, and a department for the storage and examination of explosives that has walls of concrete two feet thick. The new building will greatly facilitate the work in various lines of investigation.

## Some Spectacular Illuminating Effects at the Pan-Pacific Exposition

AT all of the large expositions, beginning with Chicago in 1893, electric illuminating effects have been specially featured, and at the Pan-Pacific Exposition, at San Francisco, special attention has been given to this effective method of lending attraction to the night scenes around the grounds, advantage being taken of many new ideas and modern improvements in apparatus to add to the picturesque impressions of the surroundings. Many special effects will be seen in connection with the different buildings, but one of the most striking and attractive will be the illumination of the immense glass dome of the Palace of Horticulture, which, surrounded by its picturesque setting of foliage, will, after dark, be a veritable kaleidoscope of changing colors.

The dome of this building is 186 feet high and 154 feet in diameter, the immense hemisphere of which above the body of the building is set entirely in glass of a slightly greenish tinge that will produce a harmonious effect with its surroundings during the day. In the center of the main floor of the building under the dome, and screened by encircling palms and decorative shrubbery, is located the electric illuminating apparatus, consisting of twelve great searchlights, each 30 inches in diameter, all directed upward to a central point, and said to produce 25,000,000 candle-power of total light. Within this circle of lights is placed a framework 15 feet high that carries the apparatus for diffusing and directing the light projected by the lamps, and the mechanism for producing the varied color effects. At the top of the framework is placed the diffusing device *C*, which is a plate of clear glass five feet in diameter and one quarter of an inch thick, that has a number of small circular plano-convex diffusing lenses cemented to its upper face, the whole forming a composite diffusing lens for evenly distributing the light over the glass surface of the dome. Immediately beneath the lens plate, and parallel with it, is located the color screen made up of three pairs of sectors of glass colored, respectively, yellow, blue, and red, the sectors of the same color being located opposite each other. This color screen is supported by a shaft which is arranged to be turned by an electric motor. Beneath the color screen, and mounted on a hollow vertical shaft, within which the screen shaft revolves, are a pair of opaque sectors, shown at *B* in the small sketch. The color screen and the opaque obscuring sectors both revolve in the same direction, but the screen makes one more revolution per minute than the sector vanes, with the result that the complete cycle of color effects will be produced each minute.

Of course the three foundation colors, yellow, blue, and red are shown at each revolution of the color apparatus, but as the opaque vanes pass from one color sector to the next there is an overlapping and mixing of the two adjoining colors, producing an entirely new series of tints. Thus, when the vane passes from the yellow to the blue portions of the screen the mixed lights produce a green tint that varies in depth according to the proportions of the two colors as the vane shifts, the tints gradually dissolving one color into the other. In the same way varying tints of purple are produced by the mixing of the blue and red, and oranges by the red and yellow mixtures. This succession of plain and mixed colors produces remarkably varied effects; and as the color varying apparatus revolves at considerable speed the play of colors is continuous and wonderful. It may also be noted that the rapid revolution of the color apparatus gives the effect of a continuous illumination of the entire dome, instead of lighting consecutive sections, as would result from a slow movement. The effect of the diffusing plate, or lens, described above is shown in the diagram, where the shaded section *B* shows the course of the beam from a single light when no diffusing lens is used, and the section marked *A* shows how the lens spreads and diffuses the beam over a great area. The lens plate described is the one that will be generally used, but four other plates, each producing a special effect, have been provided. One of these special plates will produce horizontal bars of light; another rapidly changing spots, a third gives a wriggling effect; while the fourth produces whirling rings of varying colors.

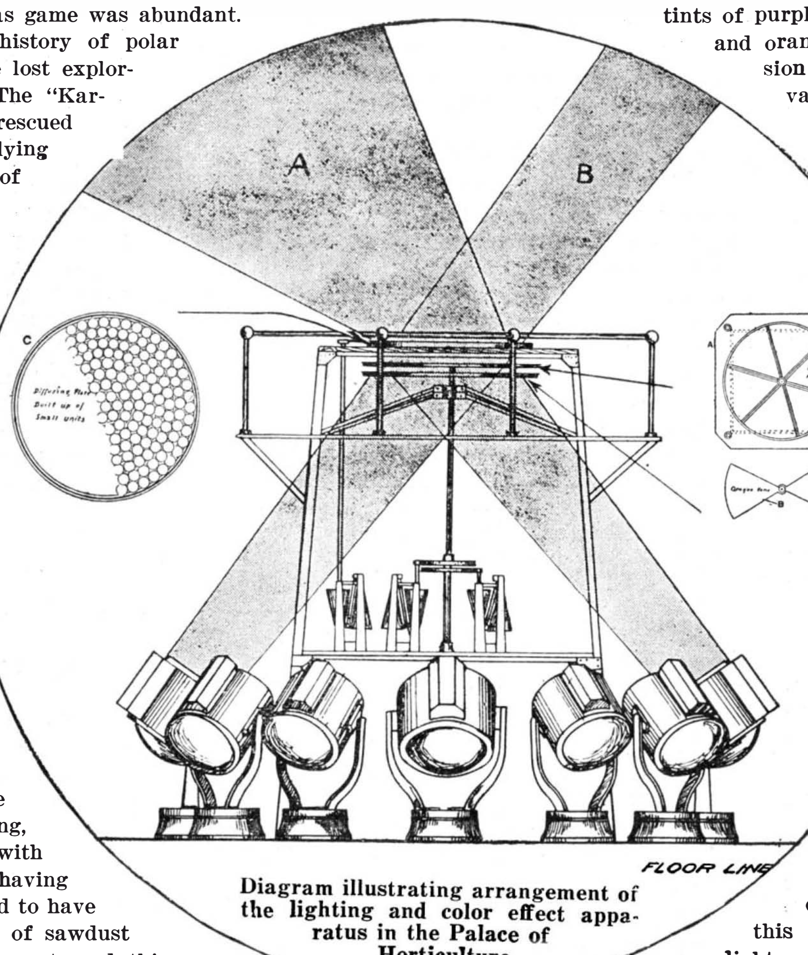



Diagram illustrating arrangement of the lighting and color effect apparatus in the Palace of Horticulture.

Outside of the buildings of the amusement concessions few of the regular exhibition buildings will be open at night, so special efforts have been made by the management to develop new and pleasing effects in outdoor lighting to make the grounds attractive, and for this purpose nearly four hundred high-power searchlights are in use, besides great numbers of incandescent lamps. In one case at least elaborate inside illumination is provided somewhat on the principle used in the Palace of Horticulture, described above. The Festival Hall contains a large auditorium with a dome ceiling having a radius of about 68 feet, and painted in light colors. In a pit in the floor of the auditorium are placed ten large projectors, the light from which passes through, and is diffused by a plate of ground glass placed in the opening in the floor. This diffused light is again diffused and reflected by the domed ceiling, but, of course, is not visible from without.

The Tower of Jewels, with its beautiful decorations, will be a center of the illumin-

ating effects, but nothing on the grounds can vie with the gorgeous color display of the Palace of Horticulture. The lighting effects at the exposition were in charge of W. d'A. Ryan of the General Electric Company, as chief engineer of illumination, and many of the unique and original features are due to his skill and ingenuity.

### The Pan-American Scientific Congress

AT a time when scientific solidarity has been so seriously impaired in the Old World as a result of the European war it is gratifying to note that preparations are afoot for bringing the scientific men of the New into closer and more friendly relations. The first much-needed step in this direction was taken at the end of the year 1908, when the first Pan-American Scientific Congress assembled at Santiago, Chile. The second congress is to meet in Washington next October, and the plans for it have been formulated by a committee headed by Mr. William Phillips, Third Assistant Secretary of State, the other members being the Director General of the Pan-American Union; the U. S. Commissioner of Education; the Surgeon General of the U. S. Army; Mr. G. M. Rommel of the Department of Agriculture; Mr. William H. Holmes of the Smithsonian Institution; Prof. L. S. Rowe, University of Pennsylvania; and Dr. J. B. Scott of the Carnegie Peace Endowment.

The congress is to be organized in eight sections, as follows: 1. Anthropology. 2. Astronomy, meteorology, and seismology. 3. Conservation of natural resources; agriculture; irrigation and forestry. 4. Education. 5. Engineering, transportation, and commerce. 6. International law, public law, and jurisprudence. 7. Mining and metallurgy, economic geology, and applied chemistry. 8. Public health, medicine.

If the history of the last congress repeats itself, the forthcoming meeting will be an event of exceptional interest, from both a scientific and a political point of view. At Santiago delegations attended from eight North and Central American countries, including the United States, and from nine South American countries, and an imposing list of papers was presented, more than fifty of which emanated from this country. The President of Chile attended the opening session, held an official reception for the delegates, and entertained all of the latter at dinner, a limited number being invited each day during the congress. Other entertainments, official and unofficial, were overwhelming in number.

**Britain's Gasoline Problem.**—According to an official British statement, America sent 17,000,000 gallons more gasoline in 1914 than in the previous year, but to offset this increase no imports were received since September. 1914, from Russia, Roumania and the Far East, except about 5,000,000 gallons, which compared with the demand of 460,000,000 gallons in the United Kingdom is but a drop in the bucket. In discussing this situation the leading British motor magazine says: "American supplies alone have prevented a famine in gasoline.

**The Palace of Horticulture at the Pan-Pacific Exposition, with its transparent dome illuminated with multi-colored lights.**

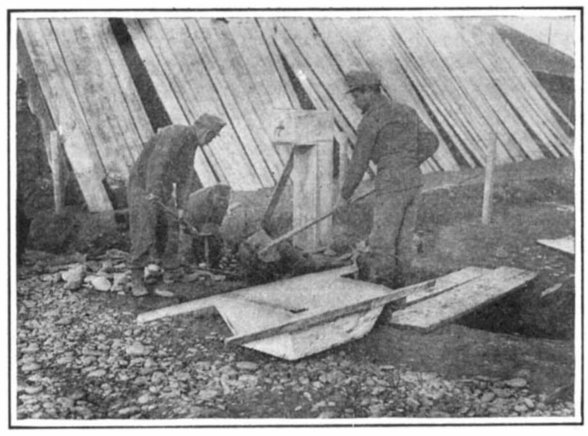
## How Epidemics are Fought in the Austrian Army

**By the Berlin Correspondent of the Scientific American**

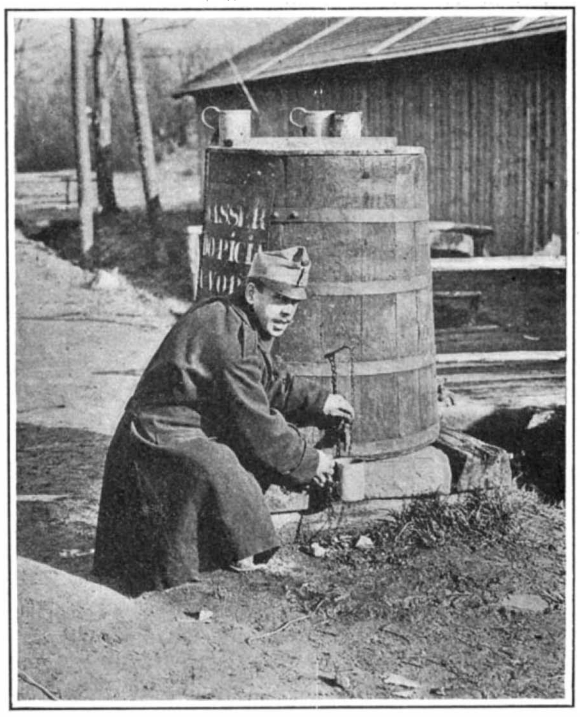
DISEASE, as our readers know, is a foe even more dreadful in war than the enemy's shells and bullets, and one of the most important tasks of modern warfare consists in improving as far as possible the sanitary conditions of an army. Alarming rumors were spread, at the beginning of this war, as to the dysentery and cholera epidemics which, it was said, wrought great havoc in the Austrian army and threatened to become a real danger to soldiers and civilians alike.

The present writer has had occasion recently to discuss the matter with somebody just returned from the Galician part of the theater of war, who thus was in a position to judge how matters actually stood. "The danger," he said, "has been definitely averted, thanks to the energetic measures taken at the very outset by the Austro-Hungarian military authorities. In fact, the cholera epidemic has never been allowed to spread beyond its original focus. Through the courtesy of the army authorities, I have been authorized to take a few photos which strikingly show the comprehensive measures taken to fight the epidemic."

The first thing done to check cholera as well as dysentery was to install in the towns and villages of Galicia long rows of barrels containing sterilized water, which the soldiers alone are allowed to use. Another effective measure consists of sprinkling the floor of railway stations with carbolate of lime and washing it frequently. Cholera patients are, of course, housed in isolated barracks, each of which is surrounded by a lime ditch. Special stretchers are used for the transport of dysentery and cholera patients.



**Lime ditches surrounding barracks in which cholera patients are housed.**



**Barrel of sterilized water for Austrian soldiers in Galicia.**

## The Meat Supply of the United States

THAT the nation faces a serious situation in the matter of meat supply is the disquieting statement of the Secretary of Agriculture in his annual report, and this condition is especially portentous when we consider the constantly increasing demand for our products that must come from Europe for many years. "Just what factors have brought this situation about no one can define with certainty," says the Secretary; and he disposes of the matter by the truly American method, of "appointing a committee."

There are, however, he points out, some directions in which efforts may be made with a view to inducing additional supplies; but the argument is difficult to reconcile in some cases. For instance, the secretary says: "It is evident that we have been considering the meat supply of the nation too exclusively in terms of the big ranch," and he immediately goes on to say, "Obviously it is important that we continue to assist in further developing the big ranch."

The directions in which the secretary sees hope for an increase in our meat supplies are: First, in a more satisfactory handling of the public grazing lands; second, in systematic attention to the production of beef animals in the settled farming areas of the country, particularly in the South; third, in increased attention to the smaller animals, such as swine and poultry; and fourth, in the control and eradication of the cattle tick, hog cholera, tuberculosis, and other animal diseases and pests.

In relation to the first point it is stated that the present methods of transforming the grasses of the public grazing lands into beef and mutton are generally conceded to be wasteful, and it is estimated that, under a proper system, the quantity of beef and mutton produced on these lands could be increased at least 50 per cent. There are about 300,000,000 acres in these lands, upon which any person can graze any amount of stock at any time; and from some remarks in the report the inference may be drawn that the grazing value of these lands has been impaired. No other result could be expected where no provision is made for the protection of the land, and there is every inducement for the casual user to get all he can out of the land in the shortest possible time. The natural result is that in this time of need little relief can be counted on from this source.

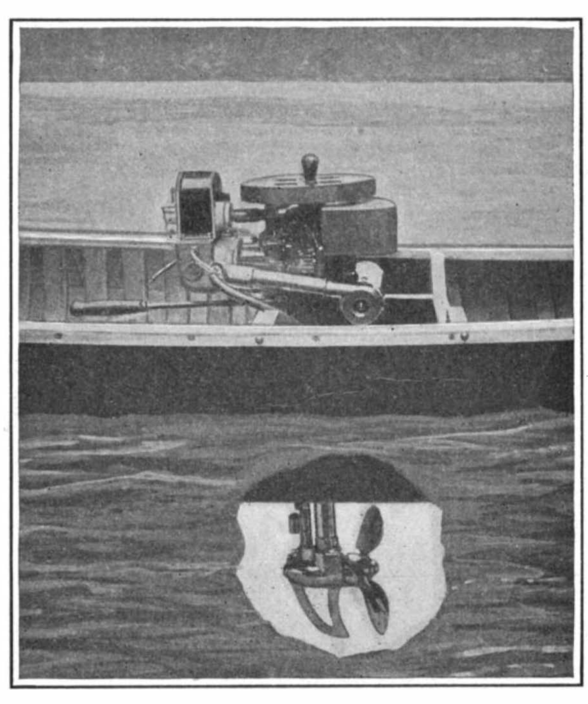
The second and third propositions would seem to hold out considerable hope, until it is recalled that in former times every farmer made it a point to raise some kind of meat product every year until conditions became such that he could not do so with the expectation of any profit; and there is no reason to suppose these conditions have changed in recent years.

There appears to be a useful field of effort in the eradication of diseases, when we consider that out of 57,000,000 animals inspected in the past year 533,000 were found to be infected with tuberculosis, and that hog cholera and cattle tick have cost the producers of this country anywhere from one hundred to one hundred and fifty million dollars in a single year.

Whatever the causes of the shortage in the meat supply it will require something more than perfunctory reports to prevent prices from going beyond the reach of the average wage earner, and that at no distant date.

## Applying Power to a Canoe

THE craving for speed and the modern disinclination to do anything that can be avoided by the expenditure of money has overtaken the canoe, the most delightful and romantic water craft that has ever been devised, for now a method has been developed for fitting a gasoline engine to the fairy boat and the poetic paddle is to be laid aside. For several years an ingenious and compact little motor set has been in use for propelling rowboats, that can be quickly attached to the stern of any boat, and a number of concerns are now producing outfits that are justly popular and undoubtedly useful; but the shape of the usual canoe has made it not altogether convenient to attach one of these motors, which are portable and secured by an adjustable clamp. Now, however, some inventive mind has conceived the idea of building a well in the body of a canoe, having an opening in the bottom and watertight sides, in which one of these little motors can be placed and conveniently attached. When thus fitted the motor shaft extends down through the opening in the well and carries the propeller beneath the bottom of the canoe, as shown in the illustration. Undoubtedly this scheme will provide quite a speedy conveyance that will cover considerable distances without loss of time; but the devotee of the silent paddle and of reposeful idling in the primitive canoe will hardly recognize his favorite craft in its new guise.



**Detachable power plant for a canoe.**

## Experiments in Hybridizing Flowers

AN article of great interest to botanists is that which describes a series of experiments in hybridizing Japanese flowers, conducted by Dr. Walter Proctor Jenney, and published in the issue of the SCIENTIFIC AMERICAN SUPPLEMENT of January 9th, No. 2036. The cause that led to the experiments was the discovery that *the dry pollen of the white moonflower, applied to the stigma of the morning glory, is inert and will not fertilize the ovary, unless the pollen be wet with the dew-like fluid excreted upon the surface of the stigma of the moonflower.*

As a result of this discovery the writer undertook a series of experiments, using the white moonflower and both common and Japanese morning glory, and following methods that departed widely from the usual procedure and which produced some exceptional results. Some of the conclusions resulting from the experiments, which extended over several years, are that hybrids of the Japanese morning glory with the white moonflower seem not to be subject to the operation of Mendel's law or are only subject to it in a limited way; this may be owing to the fact:

1. That, for some reason, the white moonflower is immune from the influence causing the seedlings of hybrid plants to vary in the second year. In this connection it is worthy of note that crosses of the Japanese and American morning glory, arising from pollenation by insects, follow Mendel's law.

2. That this exemption is due to some quality or property of the fluid excreted by the stigma of the moonflower.

A full appreciation of these interesting experiments can be had only by reading the complete article, as above noted.

## The Current Supplement

THE current issue of the SCIENTIFIC AMERICAN SUPPLEMENT, No. 2042, for February 20th, 1915, has a decided war flavor, although it contains an unusual variety of specially valuable matter. The article on X-Ray Work in the War tells us something about the use of this valuable agency as applied by the German army in field and hospital. Auxiliary Motor Cars describes special types of cars that have been developed to meet the various necessities of an army. The Making of Large Guns gives some timely details of how these weapons are made that will be acceptable to everybody. High Explosives in Warfare is one of those clearly written articles by an authority that tells just what we all want to know about an important question. Aeronautics and the War reviews general conditions and what has been done so far by the flyers, and also reviews the developments of the year. Aeroplane Darts and Fire Darts describes some novel implements of destruction developed by the war. In contrast with the above matter the article on Training for Municipal Service tells why municipal government in Germany is usually so efficient and business-like and also tells something of the work now being done in America with the same objects in view. Uniformity in Dosage of Radium Emanations discusses a therapeutic agent that is assuming considerable importance. Philosophy and Technics is an interesting metaphysical discussion of the relations of theoretical study and practical application. The Chemistry of the Flaming Arc gives much valuable information in relation to an important practical subject. Causes of Solar Heat discusses various hypotheses to explain how the sun continues for ages to emit substantially the same quantity of heat. The paper on the treatment of gas from blast furnaces is continued, and there are also articles on Instantaneous Photography Without a Camera; Thinking Animals; Wireless Telephony; The Effects of War on Crime, and notes on new and useful books.

---

**Canadian Electricity for Canadians.**—A great deal of electricity generated along the Canadian border is used in the United States. Recently the Canadian government has declared itself as opposed to the export of such natural resources when the industries of Canada develop to such an extent that they could use the whole of the energy produced, and has stated that contracts to export energy from Canada to the United States may be revoked at any time.

## RECENTLY PATENTED INVENTIONS

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

### Pertaining to Apparel.

RETAINING DEVICE FOR SHOE LACES.—ANNIE H. COHEN, care of Hebrew Orphan Asylum, 137th St. and Amsterdam Ave., New York, N. Y. This device is arranged to securely hold the end portions and tips of the lace securely in place, at the same time dispensing with tying the lace ends into bows or knots and preventing accidental untying or loosening of the shoe lace.

SHOE FASTENING.—FREDERICK DASSORI, 1135 84th St., Brooklyn, N. Y., N. Y. The invention provides means for closing the instep opening or side opening of shoes without requiring the use of laces or buttons; provides a fastening means for shoes made of a single piece of leather or similar material, which is crimped to close the meeting edges of the foot opening in the shoe, said fastener being connected at its opposite edges near the opening in the shoe, and a single fastening device being utilized for connecting the upper edge of the fastener or tongue; and provides a crimped leather tongue to be connected at its opposite edges to the shoe upper upon opposite sides of the meeting edges of the foot opening, said tongue tending to close the opening, and a device for holding the shoe in closed condition about the foot of the wearer.

TROUSERS.—A. A. BROWN, 4 Washington Place, New York, N. Y. The invention relates to alterable ready-made trousers and has to deal more especially with the waist construction whereby the trousers can be readily and quickly altered as to the waist measurements without requiring any special skill or necessitating the piecing out of the waistband lining and stiffening strips.

UNION GARMENT.—R. L. MARGOYLES, 69 Wooster St., New York, N. Y. The invention provides a suit having an opening in the rear, the body of the garment adjacent the opening being adapted to yield laterally to obviate the necessity of pulling different parts of the garment trying to enlarge the said opening when in need of using the same.

### Pertaining to Aviation.

STABILIZING MEANS FOR AEROPLANES.—J. R. JUNKIN, Box 737, Fairbanks, Alaska. An object here is to provide means for automatically maintaining an aeroplane in horizontal position and at the same time having means for permitting the tipping of the aeroplane at such times as it is desirable to have it tipped, as for instance in turning corners.

### Electrical Devices.

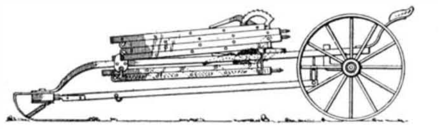
ELECTRIC CORD PLUG.—T. F. CLARK, 18th St. and Willow Ave., West Hoboken, N. J. The invention deals more particularly with detachable connectors whereby an electric light or other current consuming device can be readily attached to or detached from a lamp or wall socket or equivalent means connected with an electric supply circuit.

GATE VALVE SIGNAL.—L. A. GRIMES, 97 Dey St., Orange, N. J. This invention refers to automatic sprinkler systems and has particular reference to a means for giving a signal at headquarters or at any central station to the effect that some valve in the water distribution system has been moved or tampered with. It provides an electrical contact device for easy and quick application to standard gate valves now in common use.

### Of Interest to Farmers.

CONVEYER.—N. BRIGHAM, Whitewood, S. D. This improvement has reference more particularly to conveying means for beet harvesters, which means are adapted to pick up beets after the same have been rooted out of the ground by the plows of the harvester and to convey them to a proper place.

HARROW.—R. L. BOEHNE, Hanson, Neb. This invention relates more particularly to means for taking apart the different sections of the harrow and reassembling the same in compact form so that the harrow as a whole is in suitable condition to be conveyed from place to



HARROW.

place. The harrow is of a knockdown construction, including a frame and a number of harrow sections, so arranged that the sections, or some of them, may be detached from the frame and again connected therewith, so as to occupy changed positions relatively to the same.

SWEEP RAKE.—J. J. BOLLERUP, Naponee, Neb. This inventor provides a rake in which teeth of a novel form are so arranged in connection with associated elements as to constitute gathering tines at their forward ends, and constitute at their rear ends a carrying rack on which the running wheels are directly mounted.

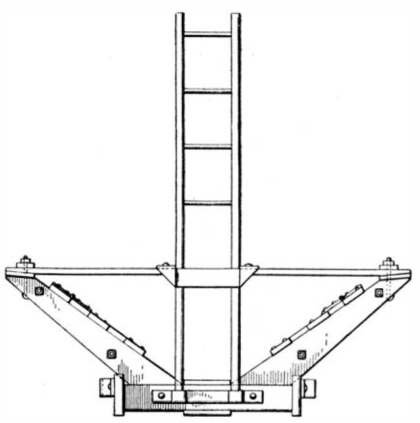
PLANTER.—W. W. HARRIS, Spartanburg, S. C. In the present patent the invention has for its object the provision of a planter with means for mounting a seed distributing wheel in a slot in the bottom of a hopper member so that the seed distributing wheel may be quickly removed.

TRAP NEST.—S. E. ELLIOTT. Address Allen C. Walker, Albion Nat. Bank Bldg., Albion, Ill. The nest is so arranged that the entrance of a fowl to the nest will close one entrance and open another, so that a record may be kept of the various fowls, the arrangement being such that when the fowl has left the nest the parts will return to their original position.

PLOW.—W. A. HART, Box 144, Cocoa, Fla. The plow is especially designed for use in cutting plants beneath the surface of the ground, in order to destroy the plants without disturbing the ground to any great extent and wherein the device is also adapted for ordinary purposes of cultivation.

NURSING PAIL.—E. THIEL, Box 5, Medford, Wis. The object here is to provide a nursing pail more especially designed for nursing calves, colts, and other animals, and arranged to insure proper feeding of the animal without danger of inducing colic or other afflictions by too rapid incorrect feeding.

HAY RACK.—I. L. OSBORNE, Redmond, Ore. The purpose in this case is to provide a combination rack capable of being expanded into sack form or contracted into compact form for handling or storing, and wherein the rack may

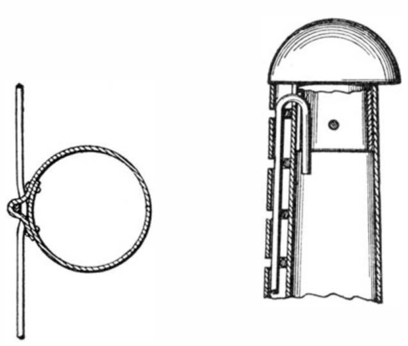


HAY RACK.

be converted into a rack for supporting hay, straw, or the like, or into a crate or cage for conveying live stock, as, for instance, hogs, sheep, calves, or the like.

### Of General Interest.

FENCE POST.—W. J. FAUNT, P. O. Box 105, Sausalito, Cal. Mr. Faunt's invention is an improvement in fence posts of the metallic type, and his object is the provision of a simple, inexpensive post adapted for holding any number of wires, and wherein the holding



FENCE POST.

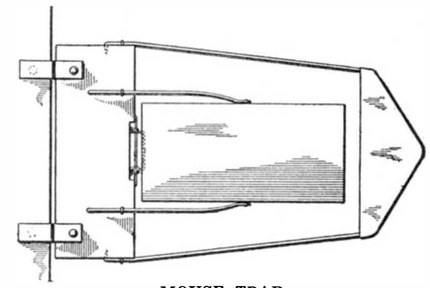
means is concealed and covered to prevent tampering therewith. The post is preferably of sheet steel, galvanized to prevent oxidization, and the steel will be of a thickness depending upon the conditions to be met. The joints are also preferably brazed, and the post may be cast instead of bent to shape.

METHOD OF COLORED PHOTOGRAPHIC REPRODUCTION.—J. LEWISOHN, 88 Fifth Ave., Manhattan, N. Y., N. Y. The process can be used with only two, or with more than three colors if desired. The principle consists in forming a series of superposing blue images, of which the preceding blue color of the image has been substituted by another color before the succeeding blue image has been formed.

HORSE COLLAR.—H. J. DANIEL, Sutherlin, Va. The invention is an improvement in combined hames and shoulder pads and relates particularly to means for connecting them and also to pad attachments of the same. The hames are provided on the outer side with the usual rein guides, and at a lower point with other guides. The upper ends of the hames are provided at the top with rings which may serve as guides for bridle reins.

TOILET CASE.—E. P. BIDWELL, care of Bush Lane House, Cannon St., London, E. C., England. The object here is to provide a toilet case more especially designed for men's use and arranged to contain a large number of toilet articles in a comparatively small space, thus rendering the dressing case exceedingly serviceable for the use of travelers and other persons.

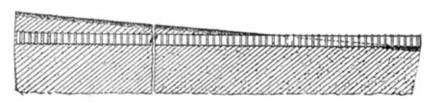
MOUSE TRAP.—H. PIERINI, Redleaf, Ark. This invention relates to animal traps and more particularly to an improved mouse trap. The trap has a platform adapted to tip under the weight of an animal, for precipitating the ani-



MOUSE TRAP.

mal into a receptacle, and having means for automatically resetting the platform so that it will be always ready for use. The trap is sanitary and inexpensive to manufacture.

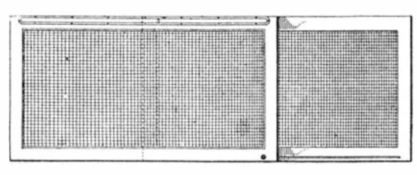
METHOD OF HARNESSING THE UNDERFLOW ADJACENT TO STREAMS IN SANDY STRATA.—J. H. HUNTER, 111 North 25th St., Omaha, Neb. The inventor has devised a method for obtaining clear water from the sand stratum, which is conducted off downstream, or to any point where it is available for irrigation, or power purposes, or for supplying towns or cities. It consists in digging



METHOD OF OBTAINING CLEAR WATER FROM SAND STRATUM.

a trench from a point up-stream to a point down-stream in a water-containing sand stratum, to a depth below low-water level; then laying in the trench a pipe whose upper end is closed; then excavating the sand adjacent to and around the closed upper end of the pipe, to form a reservoir of a required capacity; and finally unclosing the exposed end of the pipe.

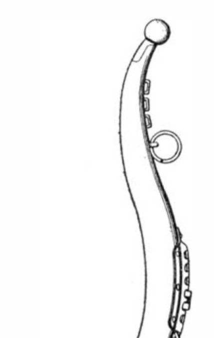
VENTILATING SCREEN.—A. R. MOLLISON, Enderlin, N. D. This adjustable screen is for use in sleeping-rooms, hospitals, Pullman cars, and other places where the admission of fresh air, without the presence of objectionable drafts, is desired. The invention provides a



VENTILATING SCREEN.

screen including a pair of cloth or fine wire screen stretched frames, and means for securing the frames together whereby they may be adjusted to each other to fit various sized windows.

HAME.—H. C. COMBES. Address G. E. Wilson, Atty., Philadelphia, Miss. This invention is an improvement in hames, and has for its object the provision of a device of the character specified, especially adapted for use in



HAME.

plowing, but suitable for any other purpose, and especially adapted to prevent the lines from becoming tangled or caught on the hames, either with a single draft animal, or a pair or more.

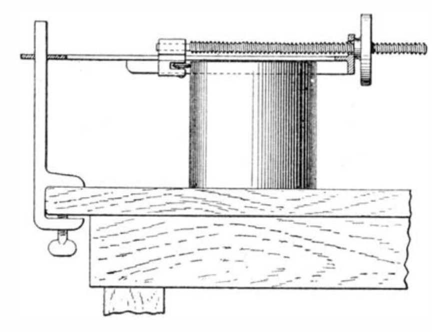
DRY PLATE CAMERA.—W. S. BENSON, 23 Delancey St., New York, N. Y. This invention relates more particularly to that variety of camera known as a dry plate camera, and has for an object to provide an improved structure wherein a picture may be taken and developed at any time without the use of a dark room.

ICE BAG CAP.—M. FINKELSTEIN, 1800 Seventh Ave., New York, N. Y. This cap is more especially designed for use on heads of persons having high fever or other ailments and arranged to securely hold the cap in position on the patient's head and without much danger of disarrangement during sleep, to allow convenient filling of the bag with ice and to drain the water from the ice bag, thus keeping the water free from the head to allow the ice to do its full share of the work.

LIFE PRESERVER.—M. A. BRAZIL, care of Amsinck & Co., 6 Hanover St., New York, N. Y. This inventor provides a device for supporting the user in an upright or standing posture; provides a floating member which will preserve its floating quality; provides a construction arranged to permit the use of offensive and defensive weapons against sharks or similar fish; and provides an apparatus adapted to be folded for storage within a minimum space.

### Hardware and Tools.

CAN OPENER.—CLARA T. HARDING, care of G. C. Harding, 102 W. Market St., Blairsville, Pa. The object of this invention is to provide an improved structure wherein the opener may be operated so as to move around the can, or the can may be removed in respect to the



CAN OPENER.

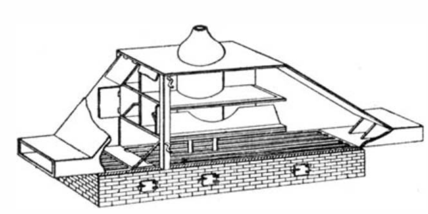
opener. Another object is to provide a guide and holding member for a can which will receive cans of various sizes and an adjustable cutting member co-acting with said guide. The opener is particularly adapted for restaurant and hotel use.

SASH FASTENER.—F. T. DAVIS, 15 South 4th Ave., Mount Vernon, N. Y. The purpose here is to provide an automatic sash fastener which is burglar-proof, and which fastener will automatically close only when the two sashes of a window are moved to the closed position, whereby injury is prevented to the window by the fastener.

GAGE AND HOLDER FOR LOCK STRIKES.—J. MACVANE, 21 Sprague St., Providence, R. I. In this case the invention has reference to gage means for use in applying a strike plate to a door jamb, and more particularly to a device having gage elements to determine the position of the strike plate on the door jamb by gaging the position of the latch bolt of the door lock.

### Heating and Lighting.

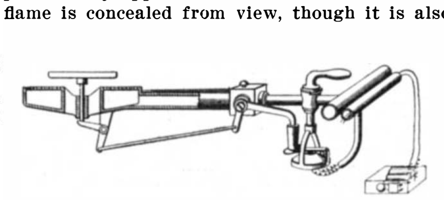
WASTE HEAT CONSERVATOR.—GUSTAV P. LUEDKE, 207 South 6th St., Springfield, Ill. This invention provides a useful gas generator for saving waste heat in smelters or plants whenever heat is lost. This generator may be also attached to another invention, devised by the inventor, for condensing noxious fumes, as in copper smelters, etc., and utilizing waste heat thereof. The hot fumes coming from the



WASTE HEAT CONSERVATOR.

smelter or furnace may be properly supplied. Charcoal, coke, or coal may be placed in the retort. By alternate blowing of superheated steam and carbon dioxide of air into the hot retort containing a hot bed of incandescent coal or coke, water gas, carbon monoxide gas, producer-gas, or coal gas, can be generated for fuel.

SAFETY GAS BURNER.—H. MENTEN, 21 Valley Place, Edgewater, N. J. This invention relates to safety economical gas burners and especially to gas burners for stoves or other devices in which gas is used for heating. It is particularly applicable to burners in which the flame is concealed from view, though it is also



SAFETY GAS BURNER.

applicable to any other type of gas burner. The primary object is to provide a gas burner of such construction that when the need for the gas flame ceases the flow of gas will be automatically cut off and a signal operated to indicate that the gas is no longer required.

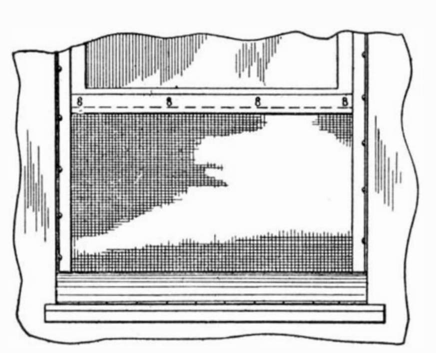
WATER PAN ATTACHMENT FOR HOT AIR FURNACES.—A. OHNEMUS. Address Excelsior Stove Mfg. Co., Quincy, Ill. This evaporating pan may be readily removed from the furnace so as to free the same from sediment

or dirt which may collect therein. The pan is in convenient position to be readily brought into view so as to fill it or to inspect its contents.

### Household Utilities.

HIGH PRESSURE COOKING UTENSIL.—T. J. Nash, 235 North 22nd St., Lincoln, Neb. This invention provides a utensil with a body and a cover together, with certain arrangements and means for evenly and tightly securing the cover upon the body whereby to render the same fluid and odor tight. By these means it obtains a higher temperature and retains all of the odor, flavor and nutriment in the food and conserves the full amount of liquid within the utensil in order that it may be continuously utilized during the cooking operation.

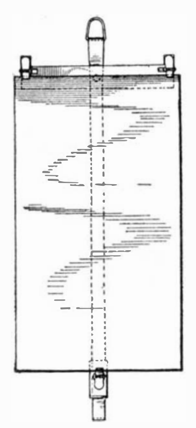
WINDOW SCREEN.—C. H. Fulde, Cooperstown, N. Y. This invention has for its main object the provision of a screen for use either



WINDOW SCREEN.

at the top, bottom, or both, of a window, and so mounted as to be movable with a sash. A further object is to provide spring means for winding said screen upon a roller in the movement of a sash toward said roller.

FLY PAPER HOLDER.—C. M. Suck, Salem, W. Va. The inventor provides a device for holding fly paper provided on its one face with adhesive substance for entangling the feet of the fly, wherein the holder is arranged to securely grasp the paper, and to hold it in such



FLY PAPER HOLDER.

position that it cannot be blown away, or blown against curtains or the like, to soil the same, and so arranged that the holder and the paper may be handled without the necessity of touching the paper itself.

BABY DRESSER AND WARDROBE.—Cora T. West, 1521 Columbus Ave., Sandusky, Ohio. The various parts of this device are arranged with reference to convenience and accessibility. The mattress is located upon the top of the wardrobe and dresser, in such position that it is readily accessible, the mattress being sunken

BABY DRESSER AND WARDROBE.

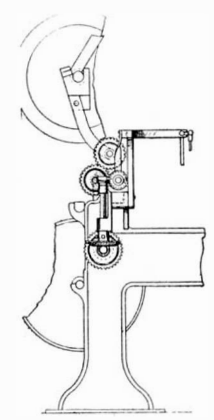
into the woodwork and so arranged as to be readily grasped by hand and removed from its mountings. The baby may be put on the dresser while it requires attention, as all articles are handy for it that are needed.

TOILET PAPER.—C. S. Humphrey, care of Talcum Puff Co., Bush Terminal, Brooklyn, N. Y., N. Y. The toilet paper roll is provided with openings corresponding to the seat on which the paper is to be used. In use, the roll is placed on the shaft or roller and the ends of the shaft or roller are inserted in the bearings of the arms. The free end of the strip is passed through the guide, and the paper is ready for use.

### Machines and Mechanical Devices.

CHECK HOLDER.—D. C. Cole, care of Shelby State Bank, Shelby, Neb. This invention provides a device embodying two relatively movable members together with means including connections between the members whereby to cause them to automatically move against and with respect to one another when a check has been placed therebetween, and whereby to permit of the ready introduction of a check between the members by the use of one hand only.

ATTACHMENT FOR LOOMS.—E. Hall, Box 136, Kannapolis, N. C. This attachment is for looms of any character, but especially for the Crompton-Knowles terry loom, and may be applied to or detached from a loom of any character, and wherein mechanism is provided for connecting a rotating part of the loom with



ATTACHMENT FOR LOOMS.

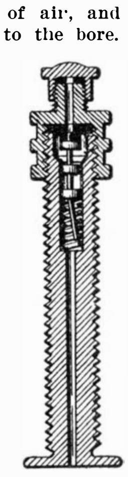
the pile rollers for operating the said rollers during the weaving of terry or pile material, to deliver an even and uniform pile of any desired length, and said connection being operated to connect and disconnect the rotating part of the loom with the pile rollers by the pattern chain. The attachment has been used with perfect satisfaction for the last six months.

STUMP BORING MACHINE.—F. A. Long, E. 827 Illinois Ave., Spokane, Wash. The invention relates to machines for clearing land, and more particularly to a machine especially adapted to operations upon stumps and thrown logs for the purpose of permitting effective fires to be started in the stumps and cutting the logs into sections which may be utilized to feed the stump fires.

WELL CASING DRILL.—J. O. Kafader, Fort Bidwell, Cal. This invention improves and simplifies the construction and operation of well casing perforators of the drill type so as to be reliable and efficient in use, inexpensive to manufacture and keep in operative condition, and so designed as to be easily and quickly manipulated and positioned.

SAW BLADE HOLDER.—A. Michie, care of Shea & Donnelly Co., Lynn, Mass. This invention relates to stone-sawing machines and particularly to the means for holding the saw-blades on the saw-frame. With the form of blade holder ordinarily employed a disturbance of the tension of the blades is a necessary incident to the shifting of the blades in the frame.

AIR VALVE.—W. E. Hedger, P. O. Box C, Waupun, Wis. In this case use is made of a valve stem having a longitudinal bore for inlet and outlet of air, and a valve chamber complementary to the bore. This chamber is



AIR VALVE.

enlarged at its outer end and receives a longitudinally movable valve stem carrying a valve disposed in the enlarged end of the chamber. A valve seat is provided on a bonnet being formed with a nipple to receive a dustcap or to connect with a pump. Means provide for giving the stem parallel guided movement in the chamber, and for seating the valve. The valve stem is disposed relatively to the bore of the valve body so as not to obstruct said bore, and is adapted to limit the inward movement of the valve.

LEVER LOCKING DEVICE.—J. A. De-Young, 572 23rd St., West New York, N. J. This invention has a special application to a throw lever provided with a latching mechanism which is co-operative with a notched segment, the device being designed to be removably attached to the lever and to fit between the lever and the grip of the latch to hold the engaging portion of the latter in positive engagement with the notched segment.

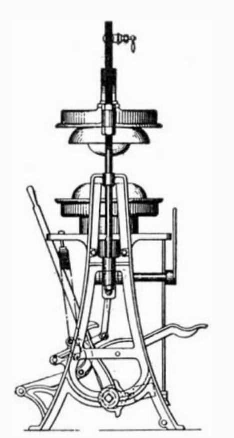
BOILER CLEANER.—J. W. Seegrist, care of W. L. Sayers, Hill City, Kan. This invention relates to the cleaning of boilers and removal therefrom of mud and other sedimentation of water which accumulates therein. It accomplishes this result without the necessity for drawing off all the water and cooling the boiler as by the present method, which method requires the services of two men for practically one half a day.

CUSHION POSITIVE CLUTCH.—M. Breth, 336 E. 72nd St., New York, N. Y. The improvement provides a shiftable clutch member having driving connection with a constantly running shaft and adapted to engage another clutch element for the purpose of starting a stationary machine, means being provided to cushion the impact whereby the driving shaft, even though operated at high speed, will not cause an undesirable shock to the driven element.

AIR PUMP.—G. Brandstetter, Hohenstadt, and R. Freund, Vienna, Austria-Hungary. The invention relates to air pumps designed to furnish vacuum and air under pressure simultaneously and in which it is desired to govern the vacuum and the pressure of air independently. In this invention the desired result is obtained by a single acting pump or by a double acting pump, one and the same side of the piston of which furnishes vacuum and air under pressure.

ENVELOPE OPENER.—A. Marks, care of the Trant & Hine Mfg. Co., New Britain, Conn. This invention provides a machine which is reliable in use and which will insure a perfect cut of the envelope at each stroke; that is to say, a cut which will be effective to open the envelope, but which will not be so long as to endanger the contents of the envelope.

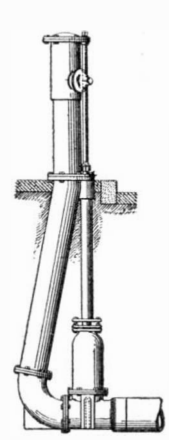
HAT PRESSING MACHINE.—J. Lake, Jr., 604 E. 17th St., Flatbush, Brooklyn, N. Y., N. Y. This invention provides means for shaping hat crowns under pressure, the pressure being applied to the crown independently of the brim; provides for contracting the crown



HAT PRESSING MACHINE.

within the desired compass and disposing the surplusage within the area usually covered by the hat band, to be in service concealed thereby; and provides means for distributing the compression area over a greater surface of the crown.

FIRE HYDRANT.—M. M. Emerson, Gotzian Block, Pearl St., Ellensburg, Wash. The present invention has reference to fire hydrants, and provides a hydrant which is economical and highly efficient and in which no restrictions are imposed upon the free passage of liquid there-



FIRE HYDRANT.

through when the valve is open and the hydrant in use, there being no internal mechanism to occupy any portion of the area of the valve section or the standpipe in the position of the parts.

### Prime Movers and Their Accessories.

INTERNAL COMBUSTION ENGINE.—H. C. Well, 1176 Walker Ave., Bronx, N. Y., N. Y. In the present patent the invention has for its object the provision of new and improved means for rotating a valve sleeve in a cylinder, the said means consisting of a crank operable by a piston rod and geared to the sleeve.

### Pertaining to Recreation.

RECREATION DEVICE.—H. Salsbury, 11 Long Acre, London, W.C., England. This invention consists in a device comprising an aeroplane structure accommodating a number of persons and adapted to partake of movements substantially analogous to those of an actual aeroplane during flight, so that when viewing animated pictures exhibited on a horizontal screen placed some distance below the structure the passengers therein shall experience the sensation of an actual flight.

### Railways and Their Accessories.

PIPE COUPLING DEVICE FOR RAILWAY AND TRAM CARS.—L. Boirault, 58 Rue Taitbout, Paris, France. This invention relates to pipe coupling devices for railway and tram cars and has for its object to so construct a device of this character that it will permit of air, steam, gas, and other similar fluid pipes being brought into operative engagement with each other by simply coupling the cars together.

JACK STAND.—N. Bacon, Sanford, Maine. This invention refers to a stand for supporting a jack in jacking up the journal boxes of car axles. An object is to provide a stand for the indicated purpose, having means to secure and support the same on a car wheel independently of the track bed.

### Pertaining to Vehicles.

DOUBLETREE CLIP.—D. B. Jacobs, Apartment 402, 4260 Broadway, New York, N. Y. This clip is arranged to allow attachment of the clip to doubletrees of various thicknesses and widths, to permit of adjusting the clip in case of shrinkage of the wood of the doubletree, to securely hold the clip in position and to allow use of the clip at the middle of the doubletree for connection with the draw pin and hammer strap as well as on the ends of the doubletree for connection with the swingletree.

SPRING SUSPENSION FOR MOTOR CARS AND OTHER VEHICLES AND TRAVELING MACHINES.—J. A. Shearer, Glen Osmond Road, Parkside, South Australia, Australia. This invention relates to the mounting of the frame of a vehicle upon its axles by means of levers connected with each axle and pivoted to the frame and adapted to be moved against the action of a spring or springs when the axle is raised so as to absorb the shock caused by rough roads or obstacles, and the object is to provide a construction which will prevent the transmission of shock or jar to the frame of the car, vehicle or machine.

SPRING TIRE.—J. F. Haeppner. Address Walter J. Smith, 1501 Gaty Ave., East St. Louis, Ill. This invention provides a spring tire, including an inner fixed rim, an outer movable rim connected to and spaced from the inner rim at a plurality of points by circular band springs, and a cover or guard plate connected to the inner rim and adapted to prevent the entrance of dust or dirt between the rims.

AUTOMOBILE SIGNAL.—E. Soule, 339 Essex St., New York, N. Y. This inventor provides a signal box or casing adapted to be carried preferably at the rear end of the chassis or limousine, and at either side or in the center thereof, depending upon the arrangement of the steering apparatus or upon the personal preference of the owners of the machines or requirements of State or municipal ordinances.

SAFETY PRESSURE DEVICE.—W. H. Walter, 68 W. 65th St., New York, N. Y. The invention provides a device more especially designed for use in the flexible connection connecting a pump with a pneumatic tire for inflating the latter and arranged to prevent inflation of the tire beyond a predetermined pressure, thus preventing bursting of the tire while inflating the same.

LUBRICATOR FOR LEAF SPRINGS.—P. E. Erickson, Port Chester, N. Y. This invention provides a lubricator for leaf springs of automobiles and other vehicles, and arranged to permit of conveniently and quickly prying the leaves apart and passing a lubricant between the opened leaves to prevent the leaf spring from squeaking and to reduce the wear thereof to a minimum.

---

Note.—Copies of any of these patents will be furnished by the Scientific American for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

---

## Classified Advertisements



## INQUIRIES

*Inquiry No. 9423.* Wanted the name and address of a concern that manufactures a product which is light in weight also pliable to the tensity of spring steel in flexibility. The material is wanted in strips varying from ¼ to ¾ of an inch in width and from 4 to 8 inches long and 3-32 to 1-16 of an inch in thickness. Vulcanized rubber would answer the purpose provided it could be made to bend.

*Inquiry No. 9424.* Wanted the name and address of a manufacturer who can supply paper twine and what is known as cardboard strip.

*Inquiry No. 9425.* Wanted the name and address of a manufacturer of supplies for model aeroplane and boat builders.

*Inquiry No. 9426.* Wanted the name and address of a manufacturer who can make ⅝" buoyant balls made into perfect spheres in large quantities. They are intended to take the place of cork. Possible wood pulp might be used.

*Inquiry No. 9427.* Wanted to secure patented device which is practical, not too expensive, and for which there is a real demand.

*Inquiry No. 9428.* Wanted to secure an interest in a manufacturing concern. Will buy part or entire interest. Must be a going concern.



### The Government Ship Purchase Bill

(*Concluded from page 177.*)

cent. From Baltimore to European ports (excepting German) rates have been increased on grain 900 per cent; on flour, 364 per cent; on cotton, 614 per cent. From Norfolk to Liverpool rates on grain have been increased from 157 to 200 per cent; on cotton, 186 per cent. From Norfolk to Rotterdam the rates on cotton have been increased 471 per cent; to Bremen the rates have increased on cotton 1,100 per cent, namely, from $1.25 per bale to $15 per bale. From Savannah to Liverpool the rates have been increased on cotton 250 per cent; to Bremen the rates have been increased on cotton 900 per cent. From Galveston to Liverpool the rates have been increased on grain 174 per cent; on cotton, 361 per cent; to Bremen the rates have been increased on cotton 1,061 to 1,150 per cent.

**Control of Rate Situation by Steamship Interests.**

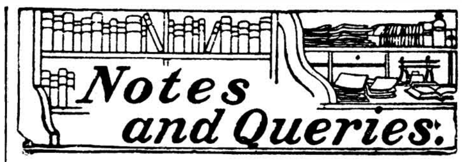
Ocean freight rates are still rising and are limited only by the greed of the steamship owners, on the one hand, and by what the traffic can stand, on the other. The Government has no power to control or regulate ocean freight rates; it cannot, under existing law, protect our foreign trade against these extortionate and hurtful charges. The steamship owners can increase rates without notice upon the instant, and our business men are helpless. The steamship companies are their own masters and they do as they please with the transportation of our exports. As already shown, they are seriously checking our foreign trade, and in some cases, such as lumber and coal, are stopping it altogether.

It may be that we cannot buy any ships. If so, great is the pity. The situation is exasperating and demands a heroic remedy. The shipping combine who are so deeply concerned lest our Government would involve us in serious complications with the belligerents, if we would buy some of the interned ships belonging to the subjects of Germany, should contain themselves in patience. The President of the United States, under whose supervision this law will be administered, may be trusted to have a greater regard for the public welfare than they have shown and to observe in letter and spirit our duties as a neutral; at the same time he will demand that the belligerents shall recognize our rights as such.

One thing is certain, the present situation has demonstrated our absolute need of an American merchant marine, not only to extend and protect our commerce in the overseas trade, but as an arm of the national defense. It is to be hoped that this lesson will not go unheeded and that selfish interests may give way to the general welfare. The plan proposed may not be the best that could be devised, but it is worthy of the consideration of all thoughtful and patriotic American citizens.

As yet no better plan has been proposed.

**Some Trade-Mark Decisions.**—Assistant Commissioner Newton in *ex parte* Conrad Seipp Brewing Company has held that the word "Hollander" as applied to beer is geographical and therefore not registrable. In *ex parte* the Yale & Towne Manufacturing Company he has held that the word "Yale" is registrable as a trademark under the ten year proviso of the Trade-Mark Act. In doing so Assistant Commissioner Newton said, "From the exhibits filed in this case it appears that the applicant's mark 'Yale' has been the subject of litigation in many suits and has been repeatedly upheld as a valid mark Applicant has furthermore registered the mark in the principal foreign countries, has vigorously asserted its rights to the mark against infringers, and it is now an exceedingly valuable mark." He also said, "It would seem to be an absurd and silly distinction to hold that Congress should have provided for the registration of the name of an individual which has been in use for ten years and not provided for the registration of the name of a corporation which had been used in good faith for ten years."




Kindly keep your queries on separate sheets of paper when corresponding about such matters as patents, subscriptions, books, etc. This will greatly facilitate answering your questions, as in many cases they have to be referred to experts. The full name and address should be given on every sheet. No attention will be paid to unsigned queries. Full hints to correspondents are printed from time to time and will be mailed on request.

(13037) C. L. J. asks: In argument with a party a short while ago, he maintained that there are three magnetic poles in the earth, one in the north polar regions, one in the south polar ditto, and one in the Sahara Desert. I have never heard of all these, in fact, was sure only of the northern one. Will you please state the facts through the SCIENTIFIC AMERICAN? A. The north magnetic pole of the earth was visited in 1831 by Sir J. C. Ross, who located it in latitude 70 deg. 5 min. N. and longitude 96 deg. 46 min. W. It was again visited in 1903 by Amundsen, who located it in latitude 70 deg. N. and longitude 96 deg. 47 min. W. The south magnetic pole was located by Lieut. Shackleton's party in January, 1909. It was then in latitude 72 deg. 25 min. S. and longitude 155 deg. 16 min. E. In 1901-1904 Capt. Scott located it in latitude 72 deg. 50 min. S. and longitude 153 deg. 45 min. E. Neither of these poles is motionless in the earth. It is not likely that there is a third pole. In Siberia there is a closed oval curve along which there is no magnetic variation, but its center does not constitute a magnetic pole.

(13038) T. A. asks: I am using a quadrant electrometer, and to charge it I use an ordinary water battery, whose use I find to be particularly troublesome, especially when the instrument is kept revolving for a long time. Could I manage to use the ordinary electric current provided for our house supply? This current is alternating, voltage 100, and cycles 60? If so, what alterations are required for the purpose? If this current won't do, what would you recommend me to use? A. A water battery is commonly employed for charging a quadrant electrometer. An alternating current cannot be employed for this work, since one pair of quadrants must be charged positively and the other charged negatively. The alternating current has no positive and negative poles. In your case the poles are reversed 120 times a second. It cannot charge a conductor nor can it produce decomposition. Nor are the commercial direct currents sufficiently constant for any exact use of them, such as your work requires. Your water battery should not be kept in connection with the quadrants long enough for it to polarize. It will then remain active for a long time.

(13039) J. B. R. asks: 1. Can a current of electricity from a storage battery or otherwise be sent into the human body and so envelop the nervous system, and carry while the person affected travels a considerable distance? A. We know of no way in which a current of electricity can be sent into a person and remain there. A condenser can be charged, and later discharged, but it is not current which is condensed. It is potential which is raised by the condenser. Current, amperes, cannot flow into a conductor and remain there ready to flow out, as water can be poured into a jug and afterward be emptied out again. If current flows it must flow around from a positive electrode to a negative electrode again, that is, from a place of higher potential to a place of lower potential. 2. Can a telephone instrument be applied at the battery end, so that you may talk along the line to the person at a distance? A. We do not know any way in which a telephone could be attached to a human body to talk to the person by means of a charge of electricity which the person is carrying around. If anything was to come of such propositions made in 1906, eight years ago, it would before this have materialized.

(13040) X. asks: Will you kindly explain a periscope as used on submarines and a water telescope? A. The periscope is an instrument enabling one under water to see over the surface of the water above. It is used on submarines, and by its assistance the submarine is directed, and its torpedoes sent to their mark. The problem of seeing to any distance below the surface has not been solved so far as disclosed. A crude instrument called a water telescope has been employed for looking down into the water. It acts simply by preventing the ripples on the surface caused by the wind, which are the chief obstacles to a clear view in clear water. In muddy water, of course, there cannot be a view of the bottom by any means whatever. The water telescope consists of a box three or four feet long and six inches square, large enough so that both eyes can be used to look into it. One end is open and in the other a piece of plate glass is set water tight. The glass end is thrust down into the water and the observer looks down through the glass. This does not magnify at all, but it does render the surface of the water under the glass entirely smooth, and thus the light rays are not disturbed by the roughness of the surface of the water, as is usually the case. Almost all the time there are minute ripples going over the surface of the water, and the larger waves prevent seeing to a greater extent than do the ripples. The water telescope, which any one can make, will increase the power of vision below the surface very greatly. The inside of the box must be painted a dull black. You will find the periscope illustrated and described in our War Issue, No. 2, price 25 cents.

## NEW BOOKS, ETC.

CYCLOPEDIA OF AMERICAN GOVERNMENT. Edited by Andrew C. McLaughlin and Albert Bushnell Hart. New York: D. Appleton & Co., 1914. Large 8vo.; 732 pp.

The need of a Cyclopedia of American Government has been made plain to the editors of this work by their own experience as students and teachers; they have often found trouble in readily obtaining brief and specific discussions of many aspects of the field. New political methods, new phrases, new facts and principles of social activity, as well as new governmental forms, are constantly coming into existence, and of many of these it is impossible to find mention in the ordinary handbook. The literature of the subject is large, but there is not in any convenient form a systematic and fairly comprehensive treatise of the whole field. The large general cyclopedias, though containing articles of considerable length, have little to say about the details of government and almost nothing about governmental practices, or the activities of what might be called unwritten and extra-legal government. The editors are confident that this work will in considerable measure supply the need for a usable, succinct and comprehensive presentation of practical, actual and theoretical government in America. The subject has been treated in a very large way, and the present volume takes us down part way through the letter F. It should be found in every library.

THE AMERICA'S CUP RACES. By Herbert L. Stone, Editor of Yachting. New York: Outing Publishing Company. 48 illustrations. 327 pp., 5½ x 8.

So full of incidents and detail is the history of the "America's" cup, that to write an adequate book on this subject within a reasonable compass calls for no little discrimination and patience. The work before us contains all the essential facts of this long struggle for the premier yachting trophy of the world; at the same time it is enriched with the essential human element which makes the story decidedly fascinating, not merely to the technically instructed yachtsman, but to the average lay reader. The author has both the technical and literary qualifications for the task, and the work has been exceedingly well done. A feature which will be appreciated is the reproduction of the sheer plan, midship section, and deck plan of all the challenging and cup-defending yachts up to the time of the "Valkyrie"-"Defender" races. Unfortunately in the plans, this history of the cup, like others which have preceded it, stops at this point; probably for the reason that the designers of the yachts covering the Lipton period of challenges have been unwilling to make public such details. Another illustrated feature which will be greatly appreciated is the series of half-tones in sepia tint with which the volume is enriched. The plates measure four by five and one half inches, and they form in themselves a handsome and illuminating collection of views, many of which are new to us. The work opens with a description of the formation and early days and best known members of the New York Yacht Club, particularly those who were interested in the original "America." The "America's" race around the Isle of Wight, in which she won her cup, is described; and thereafter the successive chapters deal in their order with the successive challenges and the deciding races of each series. Two pages of the work give, in tabulated form, the sailing lengths, the courses, the time allowed, the elapsed and the winning time for every one of the races sailed for the "America" cup.

THE TRAINING OF A FORESTER. By Gifford Pinchot, with 8 illustrations. Philadelphia and London: J. B. Lippincott Company, 1914. Size 5 x 7½ 157 pp. Price, $1 net.

The name of the author of this useful and decidedly interesting volume is a guarantee that its contents are illuminating on the subject treated of, for Mr. Pinchot for several years was the Chief Forester of the United States. In his preface the author says: "To the young man who is attracted to forestry, and begins to consider it a possible profession, certain questions present themselves. What is forestry? If he takes it up, what will his work be, and where? Does it, in fact, offer the satisfying type of outdoor life which it appears to offer? What chance does it present for a successful career, for a career of general usefulness, and what is the chance to make a living? Is he fitted for it in character, mind and body? If so, what training does he need? To answer these questions, Mr. Pinchot has drawn from his extensive knowledge and embodied the material in the volume before us. The work is illustrated with some excellent halftone engravings, full of the atmosphere of the forester's life, and we take it that the work will not only prove very useful to the young man who is thinking of taking up forestry, but it will be decidedly attractive to the average layman who loves the forests and the hills.

FAMILY EXPENSE ACCOUNT. By T. A. Brookman. Cloth. Boston: D. C. Heath & Co., 1914. 112 pp. Price, 60 cents.

Through the somewhat novel and ingenious plan of tracing the financial history of a newly married couple for a series of years, pupils are taught the value of money, how to keep household accounts, the necessity of planning in order to make their income meet the necessities and at the same time leave any sum of permanent saving. Arithmetic, domestic economy, household accounting, the writing of checks and other business papers, the placing of insurance, etc., are made very real. While learning these matters, young people are also taught certain of the fundamental facts of economic and social life. The book is to be commended because of the service it will render society, and it is to be hoped that many schools will find a place for it.

# When the Salesman Says "Continental"

The salesman says "Continental."
Or "Continental—of course."

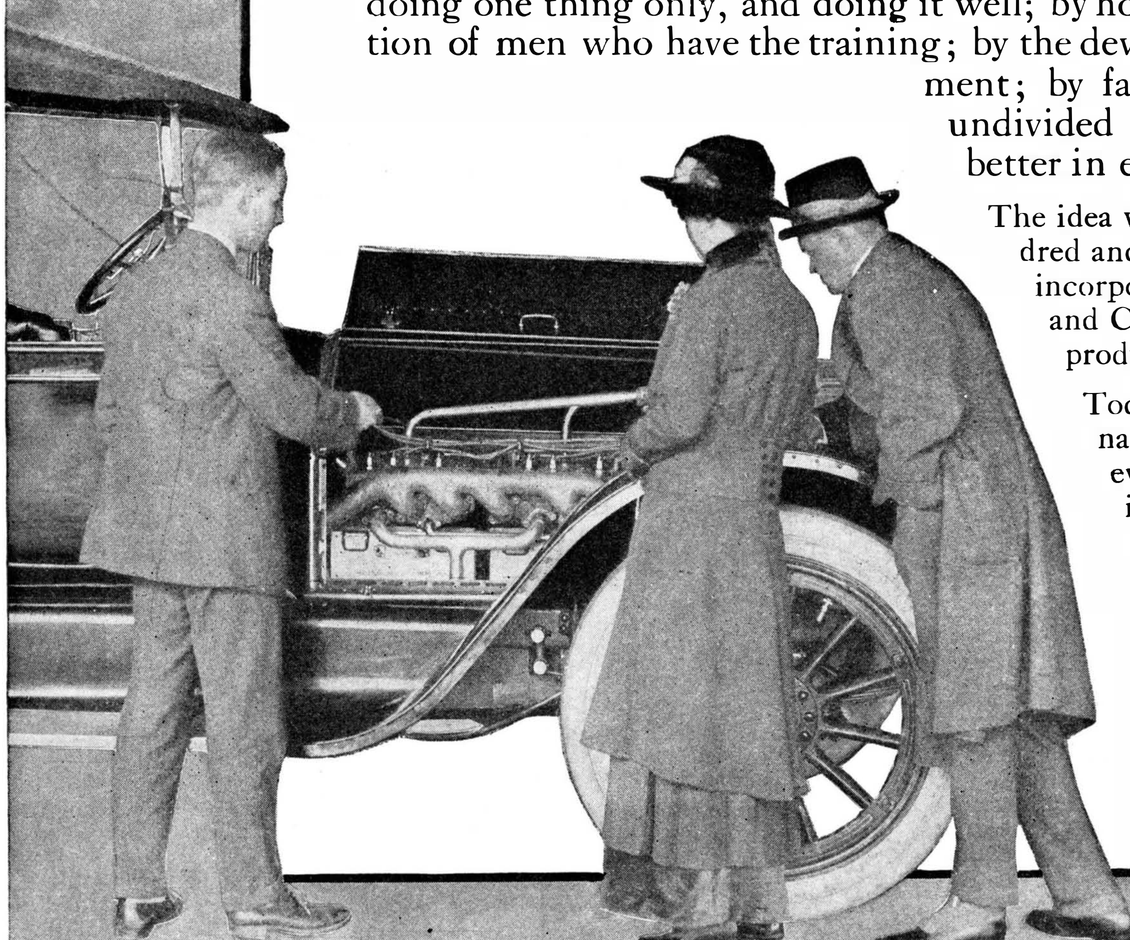
**A single phrase, yet expressing everything that may be said in praise of a motor.**

Like "sterling" as applied to the silversmith's masterpiece, it needs no further qualification. For, like "sterling," the former trade-name, "Continental" has become a world-wide symbol of unsurpassed quality.

## Continental Motors

When the salesman says "Continental" he implies infinitely more than the splendid piece of motor mechanism before him; he summons up a picture of the greatest motor-building organization in existence—the most conspicuous success of specialization in the automobile industry.

With a word, he describes the perfection of an idea—the idea that by doing one thing only, and doing it well; by holding intact an organization of men who have the training; by the developing of special equipment; by fair play, good wages and undivided enthusiasm, a product better in every way can be assured.



The idea was sound. Today, one hundred and twenty-eight manufacturers incorporate Continental certainty and Continental prestige into their product.

Today, the goodwill of the very name "Continental" is worth even more than all the millions invested in the Continental factories and equipment.

**Insist upon a Continental —America's Standard— in the next car you buy.**

**Continental Motor Mfg. Co.**
**Detroit, Mich.**
**Factories { Detroit, Muskegon**

# SCIENTIFIC AMERICAN



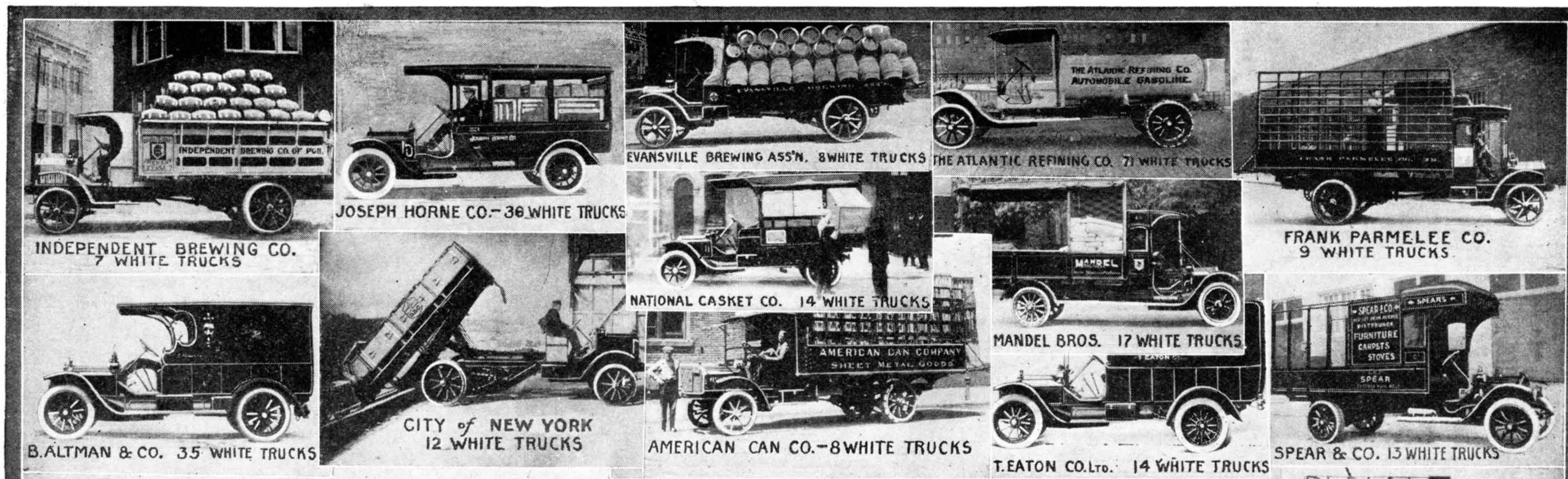


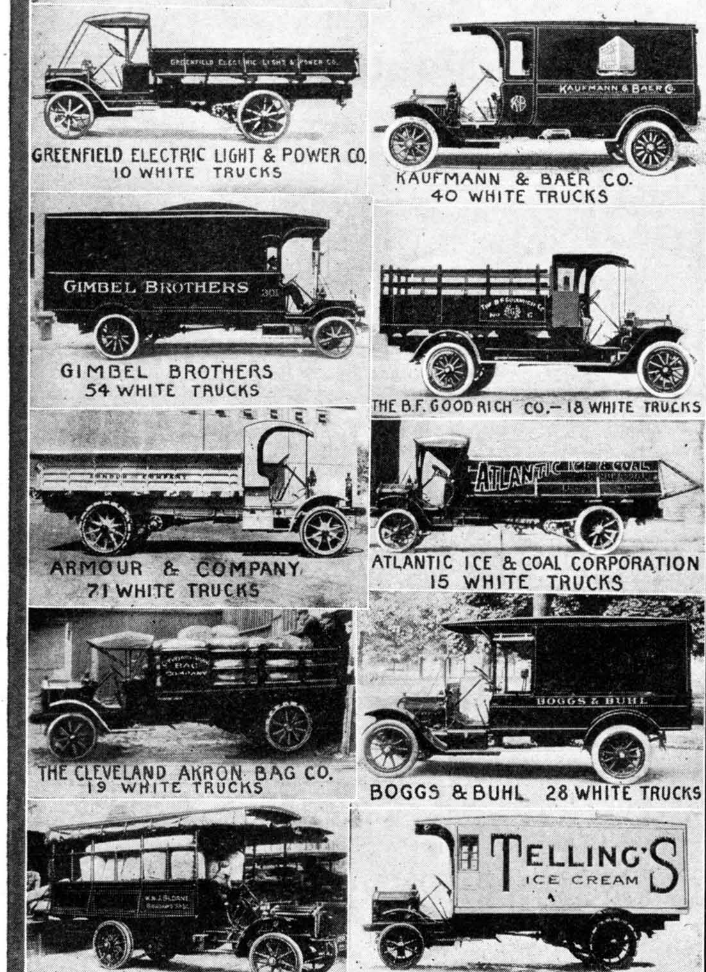
TRIUMPHAL ARCH OF THE RISING SUN, SURMOUNTED BY THE GROUP OF "THE NATIONS OF THE EAST."—[See page 194.]


Vol. CXII. No. 9
February 27, 1915

Munn & Co., Inc., Publishers
New York, N. Y.

Price 10 Cents
$3.00 A Year




# This Is Prestige

## . . . that a man buy again

THIS page is a record of White Truck *prestige*. These names familiar for the commercial wisdom they stand for nationally and locally represent purchasers of large fleets of White Trucks.

A good judge of trucks as well as one uninformed may make a mistake in his first truck purchase. But when he continues to buy the same truck again and again as his needs expand . . . the evidence of satisfaction is overwhelming.

Whether you are ready for purchase this year or not . . . permit us to send you illustrated data of White Trucks now in operation built to meet delivery conditions similar to your own.

*Exhibiting at the Transportation Building, Panama Pacific International Exposition, San Francisco*

THE WHITE COMPANY
CLEVELAND
LARGEST MANUFACTURERS OF COMMERCIAL MOTOR VEHICLES IN AMERICA



| | |
|---|---|
| New York | Broadway at 62nd Street |
| Chicago | 2635-2645 Wabash Avenue |
| Philadelphia | 216-220 North Broad Street |
| Boston | 930 Commonwealth Avenue |
| San Francisco | Market Street and Van Ness Ave. |
| Baltimore | Mt. Royal and Guilford Avenues |
| Pittsburgh | Craig Street and Baum Boulevard |
| Atlanta | 63-65 Ivy Street |
| St. Louis | 3422 Lindell Boulevard |
| Washington | 1233 20th Street, N.W. |
| New Orleans | 750 St. Charles Avenue |
| Newark | 33-35 William Street |
| Seattle | 1514 Third Avenue |
| Memphis | 278-280 Monroe Avenue |
| Dallas | 2025-2027 Commerce Street |
| Toronto | 14 Alexander Street |
| Montreal | Forum Building |
| Winnipeg | 230 Fort Street |

SEVENTY-FIRST YEAR

# SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

VOLUME CXII.
NUMBER 9.

NEW YORK, FEBRUARY 27, 1915

10 CENTS A COPY
$3.00 A YEAR

## The Bushmen of the Moori River, Natal

By D. Waterson

NEAR the source of the Moori River, Natal, some 6,000 feet above sea level, are some curious rock pictures made by Bushmen, and the owner of the property had some photos taken for me. These Bushmen, like Diogenes, have reduced their wants to minimum. They rarely build a hut, but prefer the natural caves they find in the rocks, or they form a kind of nest in the bush. Their garments consist only of a small skin; their spears are mere branches of trees, to which is tied a piece of bone or flint. The arrow is a reed treated in the same way, and all weapons are poisoned. They have no flocks and hunt with the help of dogs as wild as themselves. A rounded stone, perforated in the middle with a piece of wood inserted, serves to dig up edible roots, while fire is produced by rubbing two pieces of wood.

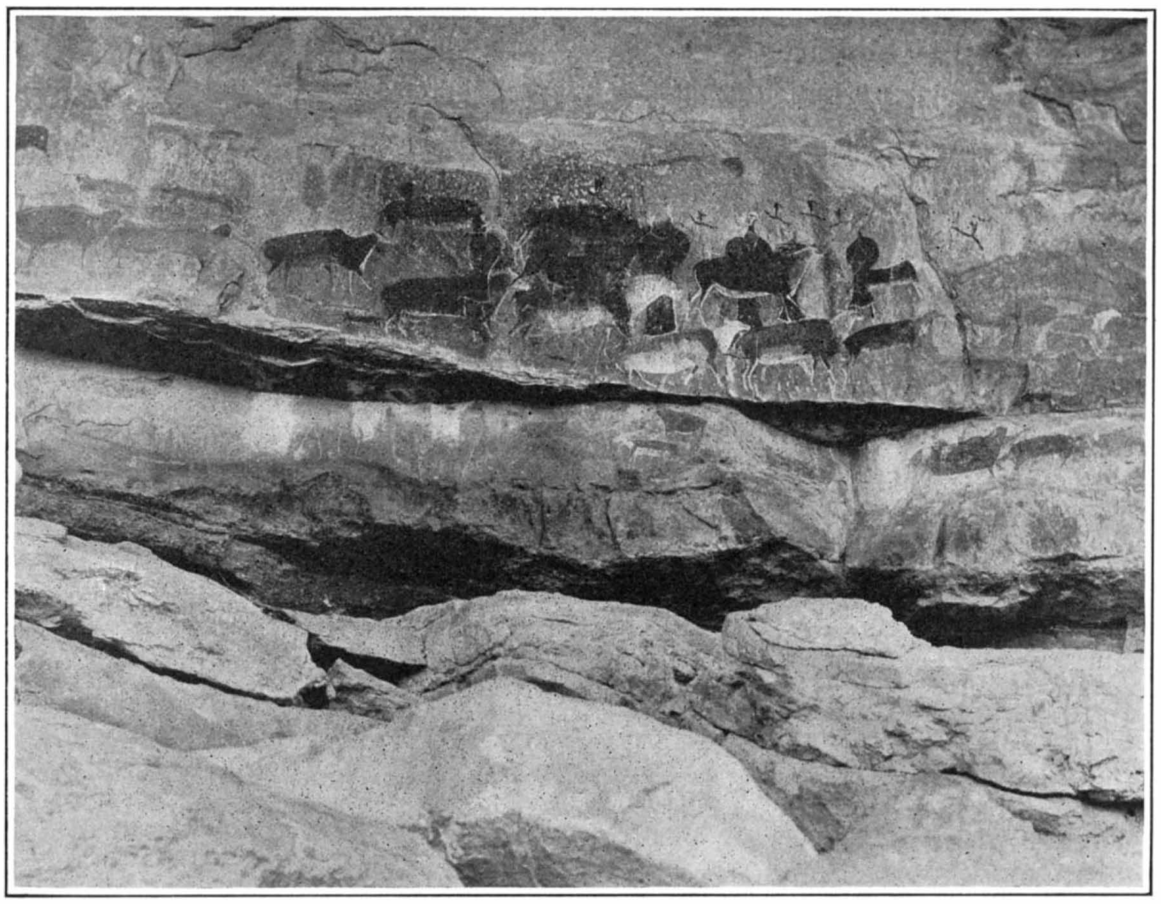
Their faculty of imitation is great, and is well illustrated by the paintings shown and by the carvings on the walls of their caves and rocks.

These are done with different colored clays, and the carving with a flint chisel only.

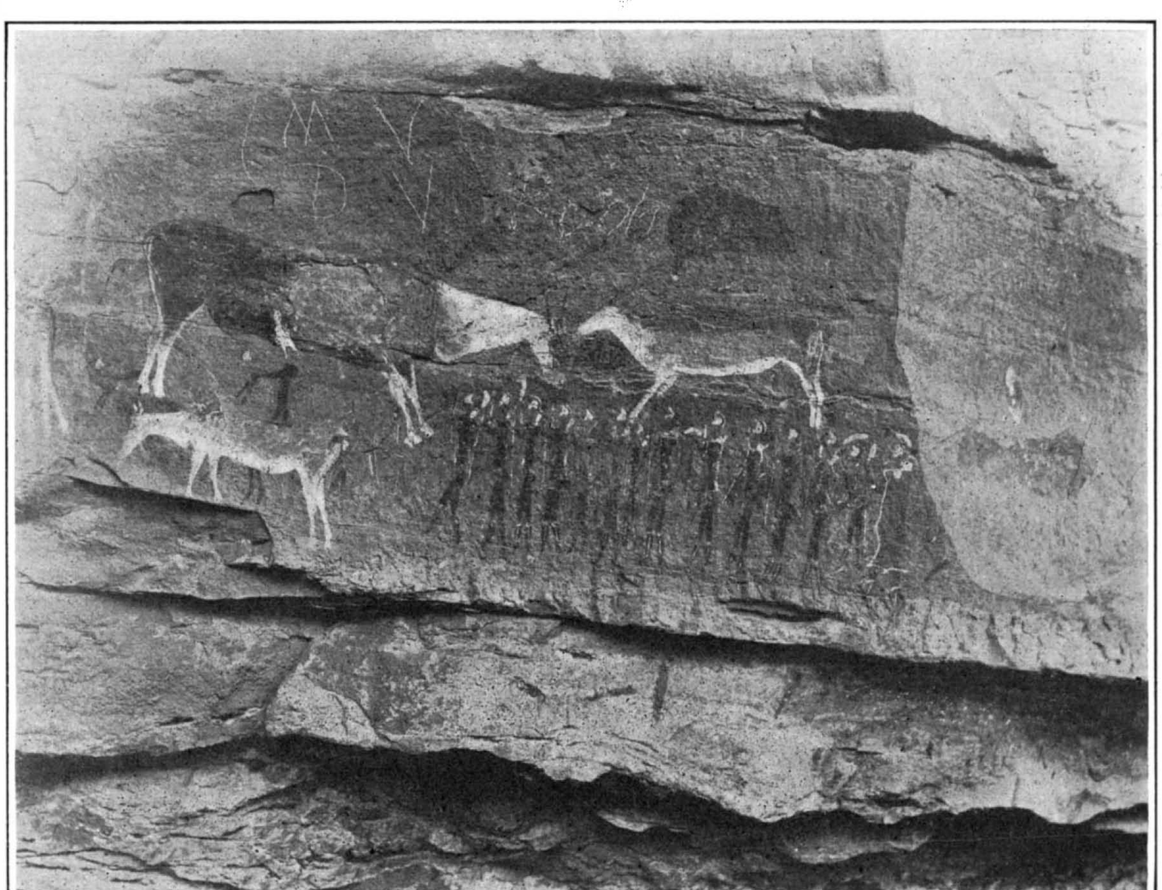
Many pictures come close to caricatures. The Boer, the Hottentot with his large feet and grotesque body are unmistakably delineated. Elephants, ostriches, antelopes, hunters are all shown.

It is a curious spectacle to see these naked savages painting with a reed or carving with a piece of flint, and coloring them with ochre.

These curious little people, light-skinned, hair growing in tufts, ridiculously developed in the buttocks, yet with very small hands and feet, are keen lovers of freedom. They acknowledge no master and possess no slaves. Possessing a most rudimentary religion they are far superior to the Hottentot, never being uselessly cruel and showing kindness to fellow tribesmen. They are distinct from all other African races, have a strange and difficult language, and are divided into small tribes scattered and isolated all over southern Africa.



Rock paintings by Bushmen, showing caves in which these men live.



Bushmen's paintings in a cave near the source of the Moori River, Natal.

## New Method for Concrete Flooring

A RECENTLY patented system for reinforced concrete flooring was applied with success to a 6-story apartment house erected at Paris. All the floors, as well as the roof terrace, were constructed on the new method of molding, which is the invention of Engineers Ferrand and Pradeau. A series of reinforced concrete beams running across the building in the usual way, serves as the basis for the flooring. A set of light planks is laid from beam to beam for scaffolding, and properly spaced at even distances. There are prepared hollow molds in plaster about 8 feet long and 5 feet wide, and about the thickness of the flooring. Such molds have a somewhat elliptical curve at the top, with straight flat bottom and somewhat inwardly sloping sides. All the plaster molds are laid upon the planking end to end, and there is a certain space between the sides of the molds, that is where they rest upon the plank, this latter of course running parallel to the molds. Then reinforcing iron rods are properly laid down, and concrete is molded on after the usual manner. The part of the concrete that lies between the plaster molds thus forms a series of vertical webs, limited at the bottom by the wood planks, and as the concrete is put on to several inches above the tops of the plaster molds, it has a flat surface all over the floor. The plaster molds remain in place and are part of the flooring, being buried in the concrete, except on the under surface, and aid in consolidating the floor, for such molds themselves are braced in their hollow cavity by two vertical webs in the middle, the walls and webs of such molds being a few inches thick. Combined with the concrete, this makes up a solid floor, and what is of great advantage is that there is now given an under surface (formed for the main part by the flat bottom of the plaster molds), which is ready to receive the ceiling plaster, without the use of lath or any other preparation. After the cement has set, the wood planking is withdrawn from underneath, for according to the reinforced concrete construction, the flooring is made to rest eventually on the main stringers of the house, the under boarding being only to uphold the work during the molding of the concrete. Because of the air space in the plaster forms, there is given an air cushion which makes such floors soundproof, this being another good point, and it is also to be noticed that the hollow plaster part makes a series of natural conduits for electric wires, piping, and the like.

## Fluorescent Photographs of Palimpsests

FOR some time the study of palimpsests has been facilitated not only by ordinary photography, but by ultra-violet photography. An even greater amount of success in reclaiming ancient texts from old parchments has been obtained recently by the use of fluorescent photography. This new method, invented by P. Raphael Kogel, was described at the meeting of the Royal Prussian Academy of Sciences, which took place at Berlin, on October 29th of last year.

The new method is based on the fact that parchment fluoresces under the influence of the ultra-violet rays, while the written characters remain almost entirely dark. Mr. Kogel states that this fluorescent photography gives on the average 50 per cent better results in the deciphering of old texts than either ordinary photography or ultra-violet photography, both of which he had previously employed. The communication was made before the session of the "*Phil.-hist. Klasse*" of the Academy.

# SCIENTIFIC AMERICAN

**Founded 1845**

**NEW YORK, SATURDAY, FEBRUARY 27, 1915**

Published by Munn & Co., Incorporated. Charles Allen Munn, President; Frederick Converse Beach, Secretary
Orson D. Munn, Treasurer
all at 361 Broadway, New York

Entered at the Post Office of New York, N. Y., as Second Class Matter
Entered as Second Class Matter at the Post Office Department, Canada.

Trade Mark Registered in the United States Patent Office




**Subscription Rates**

| | |
|---|---|
| Subscription one year.............................. | $3.00 |
| Postage prepaid in United States and possessions. Mexico, Cuba, and Panama | |
| Subscriptions for Foreign Countries, one year, postage prepaid, | 4.50 |
| Subscriptions for Canada, one year, postage prepaid......... | 3.75 |

**The Scientific American Publications**

| | |
|---|---|
| Scientific American (established 1845).........per year. | $3.00 |
| Scientific American Supplement established 1876. " " | 5.00 |
| American Homes and Gardens.............. " " | 3.00 |

The combined subscription rates and rates to foreign countries including Canada, will be furnished upon application.
Remit by postal or express money order, bank draft or check

**Munn & Co., Inc., 361 Broadway, New York**

The Editor is always glad to receive for examination illustrated, articles on subjects of timely interest. If the photographs are *sharp* the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.


*The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.*

## On the Edge of the Maelstrom of War

THE determination of President Wilson to call in all the political enginery at his command to jam through Congress a bill, whose immediate effect may well be to involve us in the European conflict, is a piece of the most amazing inconsistency that ever threatened to shake the public confidence in the prudence and wisdom of the Executive Office.

Altogether timely and fitting and universally approved throughout the country was the President's appeal to the citizens of this country, issued immediately upon the declaration of war, to preserve an attitude of the strictest neutrality.

In the same spirit and to the same degree that the country applauded that manifesto, does it now stand aghast to see its President fathering and diligently fostering a measure which, in its effect upon the warring nations, may prove to be a veritable firebrand. A conflict of the titanic nature of that now being waged in Europe shakes the whole world to its very foundations. There is not a nation, however small, whose interests are not affected and whose peace may not ultimately be endangered; and the risk of embroilment increases proportionately to the size and wealth and military and political standing of every nation affected.

The United States, as by far the largest and most important of the countries not hitherto entangled in the conflict, is peculiarly liable, because of its far-reaching interests, to be caught somewhere or other in the toils; and it is a most sacred and binding obligation upon those who happen, for the time being, to constitute our Government, to avoid taking any legislative steps which, even in the most remote degree, might irritate the overstrained nerves and susceptibilities of the great nations engaged in this war.

Now the eagerness with which the President is endeavoring to force his Ship Purchase Bill upon the country, is due to his honest, though sadly mistaken belief that this measure will solve the problem of upbuilding our merchant marine—a question in which for many years he has taken the deepest interest. We are willing to give him credit for the very highest motives, founded, although they are, upon a totally mistaken understanding of the situation. But this does not change the fact that the bill is the most serious menace to our peaceful relations with the warring nations that has developed since the opening of the war.

Say what they will, the sponsors of this measure must by this time be aware that the only possible source from which they can hope to secure the $40,000,000 worth of shipping called for is the German and Austrian ships which are at present interned in neutral ports. Senator Burton, in the article which we publish elsewhere in this issue, and at greater length in his various speeches, has shown that the proposed partnership of the Government with a corporation is a legal subterfuge, and that the ships, if they are purchased, will be, to all intents and purposes, and certainly in the eyes of international law, the property of the United States Government. Certain it is, also, that if they set sail, they will be liable to seizure by the enemy's cruisers, whether German, British, or French, and equally true it is, that should any one of these ships be found to be carrying contraband, the United States Government would stand guilty of a flagrant breach of neutrality and would be in danger of quick embroilment in the present struggle.

The President possesses a mind too logical in its processes for him not to be perfectly well aware that his insistence on the passage of a bill such as this is in direct contradiction to his attitude in urging upon the country at large the preservation of an attitude of strict neutrality.

Well might Senator Burton say, as he does in the article published on another page: "I am sorry to say that there are a great many people in the United States who do not seem to realize that we are in the midst of the most titanic conflict between nations that the world has ever seen"; and we feel constrained to add that the present Administration, in endeavoring to force this perilous measure through Congress, seems to be steering the Ship of State on the edge of the maelstrom of war with a careless fatuity that is simply appalling.

We commend to the careful attention of our readers the article by Senator Burton criticising the policy of this Administration, which is published elsewhere in our columns. To us and, we believe, to the great majority of our readers, the Senator's trenchant arguments, based as they are upon a lifelong study of the shipping problem, are simply unanswerable. Judging from the tone of the correspondence which reaches this office, the great majority of the people of this country are not in sympathy with the Administration's bill; first, because they believe that, politically and economically, it is based upon false principles; second, because it will drive what shipping we have from the high seas; and, thirdly and chiefly, because they see in it the probable seeds of war. Therefore, we strongly urge upon the constituents of the country that it is their duty to make personal appeal to their Senators, and urge them to throw party considerations to the winds and unite in the defeat of the most dangerous and menacing bill that has been brought before Congress for many years past.

## Preparedness the Only Sure Guarantee of Peace

THE assumption that the victors in the great war now being waged in Europe will emerge broken and exhausted is the deduction of ignorance and unwarranted by the experience of the past. Was the North exhausted by the civil war in the sense of being unready for further military effort? Quite the reverse—her population had increased and her host of well trained veteran soldiers, her ample equipment, and munitions of all kinds made it practicable for her to speak in no uncertain terms to France concerning Mexico. Does anyone suppose that had the North at the commencement of the civil war been as strong, as experienced, and as well prepared as she was at the end, that the South could have offered effectual resistance?

Does Russia show, at the present, exhaustion as a result of the war with Japan? Every soldier and all intelligent laymen know that Russia, from the military standpoint, greatly benefited by that war, and that to-day she has better equipment, arms, organization, and *morale* than before. Servia, small in territory, poor in resources, fought Turkey, then Bulgaria, and almost without a breathing spell has waged a remarkable campaign against the great forces of Austria—and so on *ad infinitum*.

The pacificists ask who is to attack us. The same type of people asked the same question in England a year ago. We are not urging preparation for a war with any particular people; we are rather urging preparation against war with any and all people. Certainly reasonable and careful preparation against housebreaking gives a better chance of security than open doors and complete heedlessness.

Some of our statesmen, who have been intimately connected with the building up of the present pernicious system of army posts and administration and with its continuance, state with bland simplicity that we have spent much money and must therefore be prepared. As a matter of fact, we are almost wholly unprepared, and every well-informed military man in the country knows it.

We have, it is true, more arms than we had last year, but how many more? And how long will it take us to secure the modest reserve recommended by the General Staff? This is the question the American people want answered! "All the people cannot be fooled all the time" by juggling with words and figures. The question asked is: Are we ready? The honest answer is no. No: far from it, years and years away. Every foreign power knows it and knows that we could not get ready within the period measured by a modern war. Much money has been spent, but the facts remain that the regular army is without the necessary organization—the reserve of men needed to fill up existing organizations to full strength, the reserve of ammunition for the artillery, the ammunition trains, the transport trains, and many other necessary things. The militia is even worse off, and is as a body only poorly instructed. The coast artillery is short of men and ammunition, and there are no available troops to co-operate with it against attack by landing parties. Searchlights, which are absolutely essential for coast defense, are largely wanting. Fire-control systems are in many forts improvised and unsatisfactory.

But we are told that we must be prepared because we have spent large sums of money. Other equally statesmanlike utterances are heard to the effect that a million men, full of the ardor of battle, will spring to arms between sun and sun. How utterly silly is this kind of noise. Look at England, striving to make soldiers after war has commenced, without officers or non-commissioned officers to train her recruits. Cannot we learn something from observation? Is it not time to stop talking without thinking and do something before it is too late? Ask your military experts to work out and present to Congress a plan of procedure, and for a time place the political military expert on the shelf. He costs too much.

## The Battle With Foot-and-Mouth Disease

IN view of the fact that the drastic methods used to combat the foot-and-mouth disease have evoked criticism on the part of cattle owners, statistical information in regard to the outbreak and its treatment, just published by the United States Bureau of Animal Industry, is of timely interest. Wherever a single animal in a herd has been found to be diseased, the entire herd has been slaughtered. An exception was made in the case of the National Dairy Show cattle, at Chicago, where a rigid quarantine was established and the herd spared, but the expense proved to be far too great to justify this procedure in ordinary cases. The total number of herds slaughtered was 2,046, consisting of 46,268 cattle, 7,151 sheep, 22 goats, and 47,735 swine, having an aggregate estimated value of $3,399,110. Illinois has had the largest infected area, 50 out of a total of 102 counties being affected. The animals slaughtered in that State were appraised at $1,146,985.

These figures cease to appear large when compared with the total extent of the livestock industry in the United States. On January 1, 1915, the number of cattle in this country was estimated at 58,329,000. Hence the number of cattle slaughtered in stamping out foot-and-mouth disease has been less than eight hundredths of one per cent of the total, and though the work is not yet complete the total loss will probably not exceed one tenth of one per cent. The number of animals slaughtered does not exceed the number killed in two or three days in some of the larger packing house centers. The bureau claims that if the plague had been temporized with and had been allowed to get beyond control the United States would doubtless have had to endure permanently an annual loss of many million dollars.

From a circular issued last month by the Illinois Agricultural Experiment Station we get an insight into the critical situation that has existed in that State, especially as to the differences of opinion between many cattle owners on one side and the United States Bureau of Animal Industry and the Illinois State Live Stock Commission on the other, concerning the proper methods of handling the situation.

The financial loss entailed upon individuals by the slaughter of herds has undoubtedly been serious. The federal authorities agreed to pay half of the appraised value of the slaughtered animals, and there was an understanding, but no legal provision, that the State would pay the other half. The appraised value of an animal does not cover its breeding value, nor the disorganization of farm business which results from the destruction of a herd. The latter is especially important on dairy farms, where the farm plan calls for a herd to consume the forage. Where a herd is destroyed it cannot promptly be replaced, both on account of the temporary prohibition of stock shipments and also on account of the danger of immediately restocking an infected farm.

The answer to these complaints, however, seems to be that more liberal provision should be made for making good the losses of the owners, and not that any relaxation should be permitted in the stringent measures which, in view of the remarkable infectiousness of this disease and in the light of experience gained in previous outbreaks, have heretofore been adopted by the authorities.

The fact that in *one month* the disease spread from a single point in Michigan to New England in one direction and Montana in the other indicates the magnitude of the problem with which the Federal and State officers have had to deal.

Most important of all is the fact that if this disease had been allowed to establish itself as a permanent factor in the American livestock industry, the result would necessarily have been a permanent increase in the already high prices of meat and dairy products.

## Notes on the War

**A Fine Engine Room Performance.**—The sinking of the German cruiser "Nürnberg" by the British cruiser "Kent," in the action off the Falkland Islands, was due, primarily, to the remarkable work done by the engine room and stoke-hole staffs of the "Kent." The trial speed of the "Kent," which was an eleven-year-old ship, was 22½ knots and it looked as though her attempt to overtake the 23½ knot "Nürnberg" would be fruitless. But in response to the captain's appeal, the engineering force managed to push the speed up to 24 knots per hour, or one knot more than the ship had ever steamed since she first went into commission, and gradually she overhauled and got within range of the enemy.

**A Life-saving Waistcoat.**—Men who were saved from the "Formidable" which, it will be remembered, was torpedoed in the English Channel, speak favorably of a life-saving garment, known as the Gieve Waistcoat, which can be worn underneath the coat and is inflated by means of a tube. Similar in purpose, but constructed on another principle, is the Boddy life-saving waistcoat, which is said to have been adopted by the British Admiralty. It is stuffed with Kapok, a substance five times as buoyant as cork. Eighteen ounces of Kapok are worked into each waistcoat. Because of the extreme fineness of the fibers the air is retained; moreover, there is a slight greasiness which prevents the material from absorbing water. Kapok is obtained from the pod of a tree grown in Java.

**Value of Fortresses.**—According to the Paris correspondent of the *Army and Navy Journal* it is a mistake to say that the prestige of permanent fortifications has been altogether lost as the result of the fall of Liege, Namur, Antwerp, Maubeuge and other fortified camps. The Belgian and French fortresses were sadly out of date, both in armament and in defensive organization, and were crushed by heavy artillery to which they could make no reply. The other side of the question is shown by the effective resistance of the entrenched camps of Verdun, Toul, Epinal and Belfort. These fortifications are modern; and it is a fact that they have defied the whole might of heavy German guns and the attacks of masses of German infantry. Modern guns have been added since the war, and some are being built which have a range of 18,000 to 20,000 yards.

**War and Financial Exhaustion.**—Dr. Helfferich, a leading director of the Deutsche Bank, has made a comparison between the total capital wealth of Germany and her opponents in the war. He finds that Germany has a total wealth of from 14,200 million to 15,600 million pounds sterling, France 11,400 millions, and England 11,300 to 12,700 millions, and with these he compares the United States, whose total capital wealth he estimates at 24,500 million pounds sterling. These quotations are made from a British quarterly, the *Round Table*, which states that in a war of the present magnitude, every country undoubtedly lives on its capital to a great extent. All expenditures are reduced to a minimum; the country's fixed plant runs down, and generally speaking the wealth of the country diminishes. Nevertheless a country can live partly on its capital—just as a private person can—for a very long time.

**High Angle Fire on German Warships.**—The usual range of elevation for the guns of the main battery of warships is from 5 degrees below the horizontal to 15 degrees above; but the Germans have given to their guns big and little, the ability to elevate to 30 degrees above the horizontal, or even more than that. The object of this was to enable the guns to be elevated above the horizontal, even when the ship, due to penetration below the water line, was listed several degrees toward the enemy,—a very wise provision. This arrangement has conferred the added advantage of greatly increasing the range, and the result was shown in the Falkland Islands fight when the 8.2-inch shells of the "Scharnhorst" reached and several times struck the British battle cruisers at a range which was probably between 14,000 and 16,000 yards. At that distance the falling angle of the German shells is stated to have been fully 45 degrees.

**The So-called Blockade by Submarines.**—One hesitates to speak of the humorous side of such a ghastly tragedy as the present war in Europe; nevertheless the statement of the German government that it was about to establish a blockade of Great Britain by its submarine fleet must have provoked a smile among naval men and all those who are familiar with the limitations of the submarine and the small number in Germany's submarine fleet. If we take into account the known and the possibly larger unknown losses among the German submarines, it seems probable that at the present time they do not possess more than thirty to forty of these vessels. If they had from three to four hundred of the very latest type, the threat might amount to something. That the German boats can now and then find themselves athwart the course of an unarmed tramp and get near enough to sink it, is quite possible. But to announce that a blockade is to be established is to be guilty of a bluff of the first magnitude.

## Science

**The Anglo-Swedish Antarctic Expedition,** which was to have sailed this year for five years of exploration from a base in Graham Land, has postponed its departure until 1916 on account of the war.

**Meteorological Observations in Germany.**—A letter from the director of the Royal Prussian Meteorological Institute, quoted in the *Monthly Weather Review*, states that regular meteorological observations are being maintained as usual throughout the German Empire, notwithstanding the war. Weather forecasts are issued regularly, though the cessation of cable and telegraphic reports from a number of foreign stations, including those in Iceland, makes the forecaster's task unusually difficult.

**A New Building of the Mellon Institute Dedicated.**—The new building of the Mellon Institute of Industrial Research and School of Specific Industries, University of Pittsburgh, was dedicated on February 26th, the address being made by Dr. Rossiter Worthington Raymond, and a reception was given in the new building in the evening. The first Mellon lecture in the lecture hall of the new quarters was announced for the following day, to be delivered by Prof. John J. Abel, of Johns Hopkins University, under the auspices of the Society for Biological Research of the University of Pittsburgh, whose subject was "Experimental and Chemical Studies of the Blood and their Bearing on Medicine."

**Tetanus in Vaccine Virus.**—The Public Health Service has published as Bulletin No. 95 of the Hygienic Laboratory the results of certain investigations by Surgeon Edward Francis, which, according to the Surgeon General, 'will undoubtedly be of much value in overcoming the alarm in certain quarters as to the danger of contracting tetanus from vaccination." An attempt was made to produce tetanus in monkeys by virus artificially contaminated with tetanus spores. The result was altogether negative, from which is inferred the difficulty, if not the impossibility, of producing tetanus in human beings by the same process. Two cases of tetanus, supposed to have resulted from vaccination, were investigated, and in each instance it was found that the tetanus organism had undoubtedly been introduced subsequent to vaccination, probably owing to lack of care of the wound. The service finds in these two fatalities confirmation of the belief that the use of a vaccination shield in the absence of certain, frequent and careful attention of the wound is to be condemned.

**Fish Culture on Farms.**—The last annual report of the Commissioner of Fisheries calls attention to the desirability of developing widespread interest in pond culture, both in artificially constructed fish ponds and in the natural inland waters of small area in this country. Thousands of acres of land unsuitable for agriculture or other established industries might be made to yield fish, and this movement might help to bring down the cost of living. The Commissioner says: "It is very common to see ponds, swamps, and small sheets of water lying useless, and marshy meadows producing nothing except a small quantity of inferior grass. With a small amount of labor and capital such places might be transformed into ponds, which, aside from their value for fish culture, would be of material benefit to farmers as reservoirs for the storage of water for irrigation during periods of drought." Young fish for stocking ponds and all necessary advice and instructions can be obtained free of cost by addressing the Commissioner of Fisheries in Washington.

**The House Centipede** (*Scutigera forceps*), which has always been a too familiar inhabitant of human dwellings in the southern United States, has gradually spread northward, until now it is very common throughout New York and New England, and extends westward well beyond the Mississippi. The Department of Agriculture has just issued a brief bulletin in regard to this creature, which is not a true insect, but one of the myriapods. It thrives in damp places, being particularly abundant in bathrooms, moist closets, and cellars, multiplying excessively also in conservatories, especially about places where pots are stored, and near heating pipes. The centipede, like other members of the animal kingdom, including man, is neither wholly bad nor wholly good. It feeds on house flies, roaches, moths, and other forms of life commonly rated as pests, probably including bedbugs. Its method of catching an insect seems to be to spring over it, inclosing and caging it with its many legs. The belief occasionally met with that the centipede feeds on household goods and woolens or other clothing is without foundation. On the other hand, the bite of this creature is undoubtedly more or less poisonous, the effect depending upon the susceptibility of the patient. There are, however, very few cases on record of its having bitten any human being, and it is very questionable whether it would, unless provoked, attack any large animal. If pressed with the bare foot or hand, or if caught between sheets in beds, it will undoubtedly bite in self-defense, and severe swelling and pain may result. Prompt dressing with ammonia is the best treatment of such bites.

## Astronomy

**A New Comet.**—A telegram received at Harvard College Observatory from Mr. John E. Mellish, of Cottage Grove, Wisconsin, announces the discovery of a small bright comet by him in R. A. 17h. and Dec. + 3 deg. The comet was moving slowly eastward.

**Absolute Size of the Stars.**—The latest attempt to determine the absolute diameter of a number of fixed stars is that of Signor Ferrara, of Teramo, Italy, who publishes his results in the *Rivista di Astronomia*. Among the stars having a measurable parallax he estimates, from photometric measurements, that Canopus is the largest, with a diameter 51 times as great as that of the sun. Other large stars, and the ratios of their diameters to that of the sun, are: Castor, 18; Arcturus, 10.4; Pollux, 8.7; Capella, 8; Vega, 6.8. Such determinations are, of course, highly problematical.

**Maintenance of Solar Heat.**—Discussing this well-worn subject in the *Comptes rendus*, M. A. Véronnet attempts to calculate the time the sun's activity could be maintained by (1) chemical action, (2) intra-atomic energy (radium), and (3) the work of gravitational contraction. For the first he gets 2,000 years, for the second only 170 years, while for the third he finds that gravitational contraction, according to the well-known theory of Helmholtz, would account for several millions of years of solar heat, as demanded by the geological record. The fall of meteorites into the sun could account, at most, for only the four hundredth part of the sun's heat.

**Meteor Observations in America.**—The American Meteor Society has announced that it would be glad to secure any unpublished meteor records, of any year, and to undertake their discussion and reduction. Communications on the subject should be addressed to Prof. Charles P. Olivier, Leander McCormick Observatory, University of Virginia. This society, founded in 1911, has a membership of only twenty; a good index of the small amount of attention paid in this country to the observation of meteors. The members include both amateur and professional astronomers, who make their observations in accordance with a uniform plan, and forward the results to the headquarters of the organization to be digested and published.

**Why Jupiter has Belts.**—It has been suggested by Lau that the reason Jupiter has belts instead of zones of spots is to be found in its rapid rotation. The material forced upward from the lower strata of the planet, bringing with it a smaller linear velocity than that of the surface, streams eastward and assumes the appearance of elongated streaks. If the centers of eruption are sufficiently numerous, belts are formed; and it is suggested that, were the sun's rotation much more rapid than it is, the solar surface at spot maximum would also present dark streaks or belts. In accordance with this theory of belt formation it will be remembered that the great revival of Jupiter's north equatorial belt in 1912-1913 began with the outbreak of a few isolated dark spots, which quickly spread out around the planet.

**Canada's 72-inch Reflector.**—Work is progressing rapidly on this instrument, which will be probably, for a short time only, the largest telescope in the world (pending the completion of the 100-inch reflector for Mt. Wilson). The disk for the great mirror started from Antwerp about a week before the war broke out. After its arrival at New York the Pennsylvania Railroad was about a week in finding a suitable car to transport it to Pittsburgh, and then there was further delay before an iron wagon could be obtained to transport it to Dr. Brashear's workshop, where it was finally placed on the grinding table. The hazardous work of boring and smoothing off the hole in the center of the mirror has been accomplished with entire success. It is expected that the mounting will be completed by October next.

**Wave Lengths and Radial Velocities in the Orion Nebula.**—The application of the interferometer to astronomical purposes, as described by Messrs. Fabry and Buisson in the *Astrophysical Journal* for June, 1911, has since yielded interesting results which have from time to time formed the subject of notes in the *Comptes rendus*. The latest of these records measurements of radial velocities in the portion of the Orion nebula which contains the "trapezium." From these it is found that the distance between the nebula and the earth is increasing at the rate of 9.8 miles a second. While this is the average of measurements at different places in the nebula, the actual radial velocity varies from point to point; in other words, the nebula is not moving with the coherence of a solid body, but is undergoing numerous local deformations, besides which, in the region examined, there is a movement of quasi-rotation around an axis running from southeast to northwest. Having determined the radial velocity by the use of a hydrogen line, measurements were made of the apparent wave-lengths of the nebulium lines, in the ultra-violet, and these were corrected for the radial velocity, as previously determined, in order to obtain the absolute wave-lengths of the nebulium lines, which were found to be 3,726.100 and 3,728.838. These do not correspond with the lines of any known terrestrial element.

# The Great International Panama-Pacific Exposition

How the United States of America Will Commemorate a Great Engineering Achievement That Promises to Effect a Readjustment of the Lines of Commerce of the Entire World

An Exposition Which Will Symbolize the Advance of Humanity and Which Will Contribute to a Better Understanding of Peoples and the Widening of the Influence of the United States

The Fountain of the Earth.

AT its inception undoubtedly the only thought of the purpose of the Panama Canal, at least in the mind of the general public, was the closer linking of the great Pacific coast region of our country with the East, a closer commercial and social connection that would be of common benefit to all; but as time passed, and conditions were studied more carefully, it became evident that the Panama Canal was destined to become an epoch-making factor in the world's history, not only

Façade of the Palace of Machinery.

through the re-adjustment of the lines of commerce which it will compel, but fully as potently through the influences that result from the drawing together of great nations following improved facilities of communication.

Comparatively few people realize that the west coast of North America has been practically isolated from the rest of the world, and although a region of vast resources and possibilities it has been so difficult of access that it is practically undeveloped. The same is true, in varying degrees, of the coast of Siberia, Western South America and Australia, not to speak of the numberless islands of the Pacific, for indeed the entire territory lying in and adjoining the vast Pacific Ocean has suffered more or less from this difficulty of access.

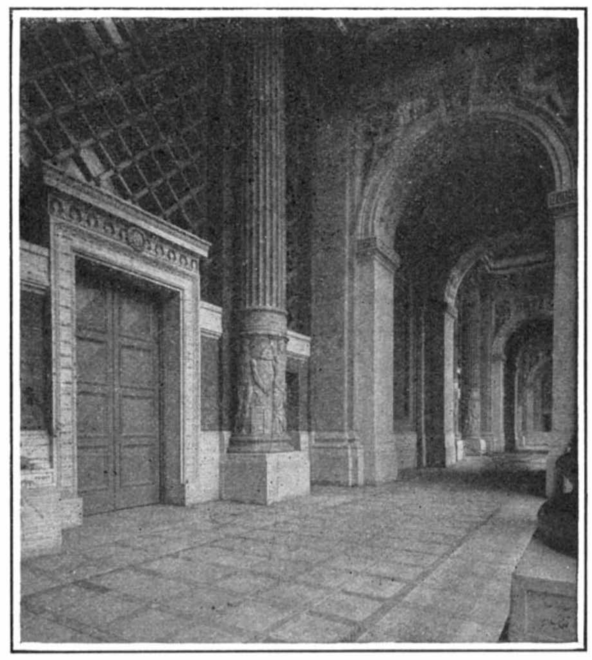
The Suez Canal did much to improve this condition, but the penetration of the Panama Isthmus will undoubtedly have a more radical effect. The Panama Canal opens up lines of communication untouched by Suez, and probably affecting much more extensive areas, that must have a momentous effect on the tide of trade and emigration within a few years, especially under the upheaving influences of the war in Europe.

While the Canal brings these great territories into easy communication with the rest of the world its special influence upon conditions in the United States is more direct, and the results are tremendous in their possibilities, for the Canal puts us into closer touch with territories including one fifth of the land surface of the world, and a third of its population, than London or Hamburg, and the possible influence and benefits arising from such a connection are too vast to be understood or appreciated at the present time.

**Why the Exposition is a Fitting Way of Celebrating the Canal.**

It is such a momentous event, far overshadowing the engineering and administrative triumphs of the actual work of construction, notable as these are, that the Panama-Pacific Fair is intended to celebrate and announce to all people, and apparently its organizers and creators accomplished their purpose and realized their ideals in a way that will be a credit to their country.

In planning the exposition it was decided to divide the buildings into three principal groups, massing the great exhibition palaces in the center, while the pavilions of the nations, and State buildings, lie to the west and the amusement section, the "Zone," is located nearest to the heart of San Francisco. The base of the central group is a great quadrangle composed of eight immense exhibition palaces, similar in character and separated by three great courts running north and south between the three pairs. In the center is the vast Court of Honor, the Court of the Universe; on the west is the Court of the Four Seasons; on the east is the Court of Abundance. Huge colonnades screen the walls of the buildings, extending from the openings of the courts upon the harbor back to the courts themselves, and almost encircling them. The walls of these vast corridors are red, their vaults Venetian blue. Red, blue, green, and golden brown in pastel shades line the re-

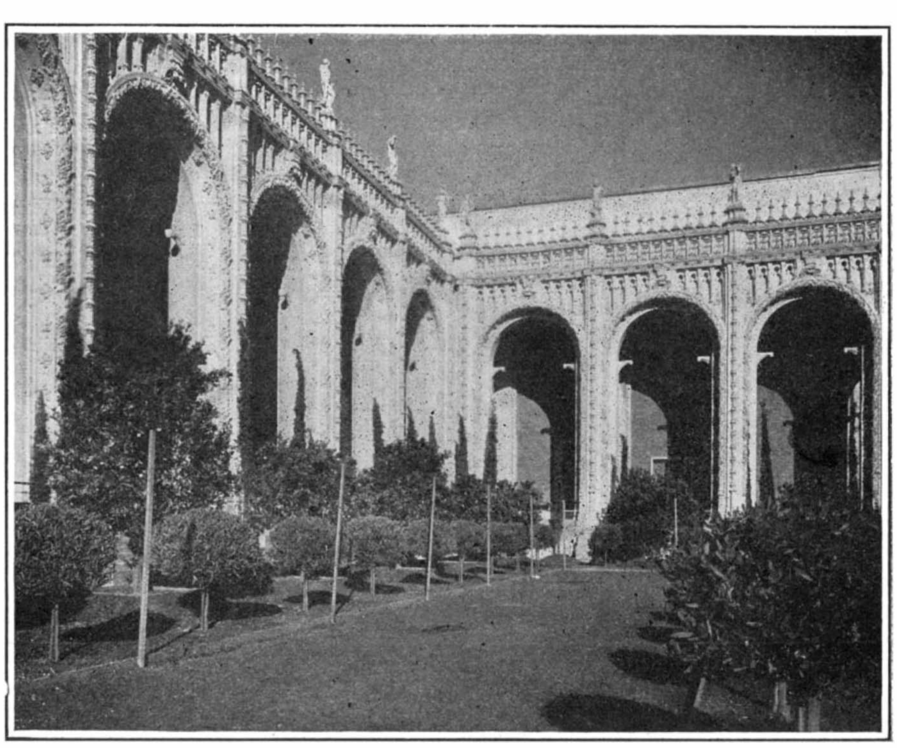


Vestibule of the Palace of Machinery.

cesses in the courts, silhouetting in color great groups of statuary placed within niches. Superb mural paintings by William DeL. Dodge, Frank Brangwyn, Milton H. Bancroft, Edward Simmons, and other famous artists will be placed upon the walls of the courts behind the colonnades or will ornament the vaults of great triumphal arches.

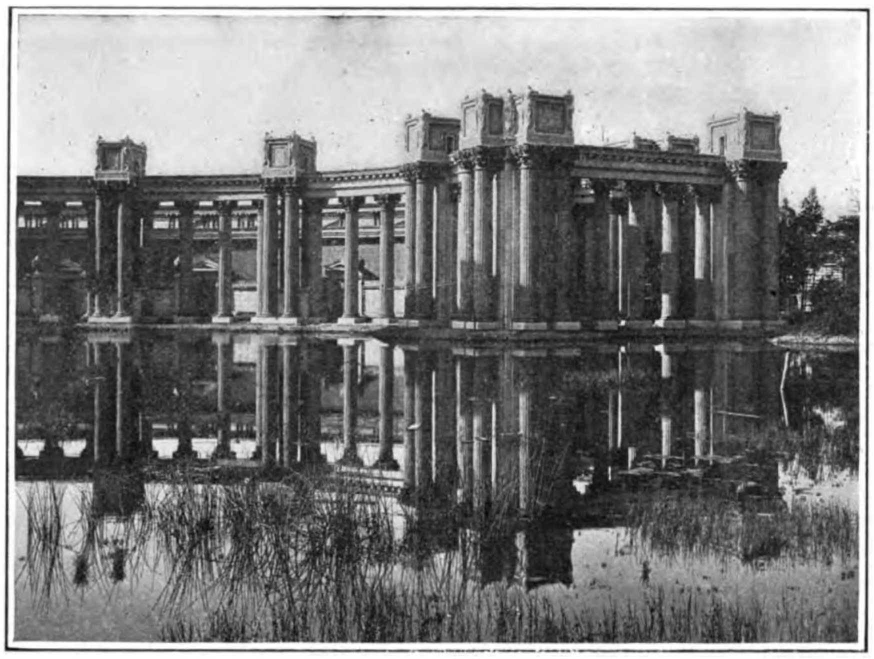
The huge domes rising from the center of eight of

* Illustrations of this article copyrighted by the Panama-Pacific International Exposition, 1915.

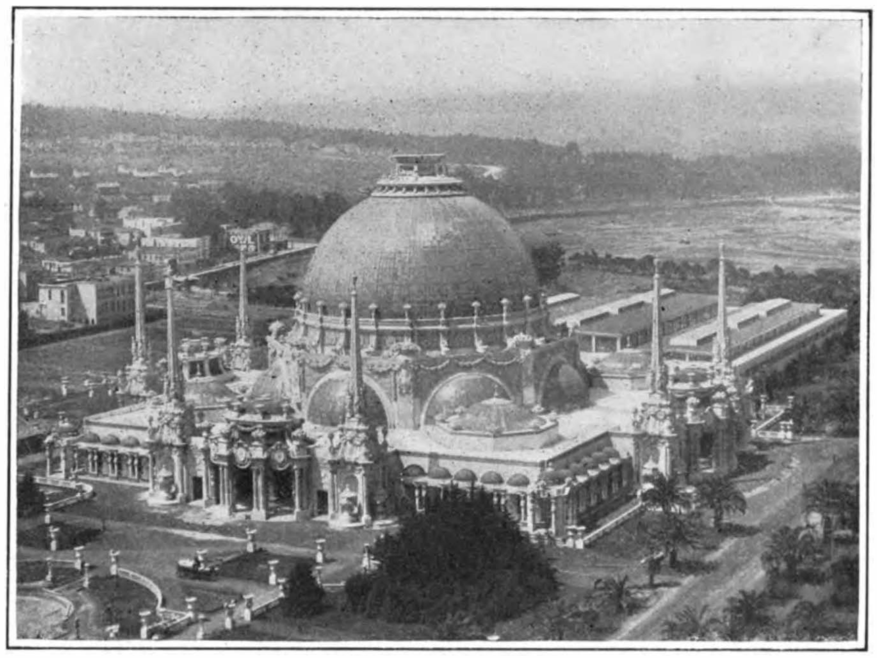


A corner in the Court of Abundance.

Unique half dome in the Court of the Four Seasons.



Exquisite colonnade of the Palace of Fine Arts.



The Palace of Horticulture with its beautiful dome.

the main exhibit palaces are their most conspicuous architectural feature. These domes rise 160 feet above the floors of the buildings, are 100 feet in diameter and are set upon great octagonal bases that rise at the intersections of transverse and longitudinal naves that run through the centers of the palaces. The lattices in the bases beneath the domes are of green with glints of gold showing between their intersections.

To the south of this group of buildings is the beautiful South Garden, flanked on one side by the wonderful Palace of Horticulture, with its Saracenic architecture suggested by the Mosque of Sultan Ahmed I; and on the other by the magnificent Festival Hall. To the west of the main group is the Palace of Fine Arts, a creation that well merits its name.

**The Wonderful Tower of Jewels.**

The central architectural feature of the grounds is the Tower of Jewels, a Babylonian effect that rises 435 feet high by a series of seven decorative terraces, and is surmounted by a triumphal group of figures supporting a globe, typifying the world. This is the work of Thomas Hastings of Carrere & Hastings, and suspended upon its walls are 125,000 "jewels" of cut glass that scintillate in the sun, and at night glisten and radiate multitudes of beams reflected from the many colored lights that are arranged to play upon the tower, as well as most of the other principal buildings. Through the base of this tower entrance is given to the Court of the Universe by an archway 125 feet in height, and set within a vast colonnade in its base are the two great fountains, the Fountain of El Dorado and the Fountain of Youth.

Contrary to general expectation, the architecture of the exposition buildings is not of the Mission style, but the prevailing character is rather the Italian Renaissance and Greco-Roman. There is, however, a flavor of Spanish architecture, but of the highly ornate High Renaissance Spanish style, and the Hispano-Moorish. Decorative detail has been used with a lavish hand, but also with taste and judgment, and days could be spent in studying and admiring these subordinate features alone. Upon the architectural effects and details the best thought of the country has been bestowed, and the results have surpassed anticipation.

The general character of great fairs has tended to settle into certain general lines, but in the case of the Panama-Pacific the richness and variety of the architecture and the luxuriance of the decorative detail preclude all possibility of an impression of sameness, while a special feature of the decoration gives the exhibition as a whole a daring character of novelty and a beauty that is individual.

**Not a "White City" but a City of Color and Beauty.**

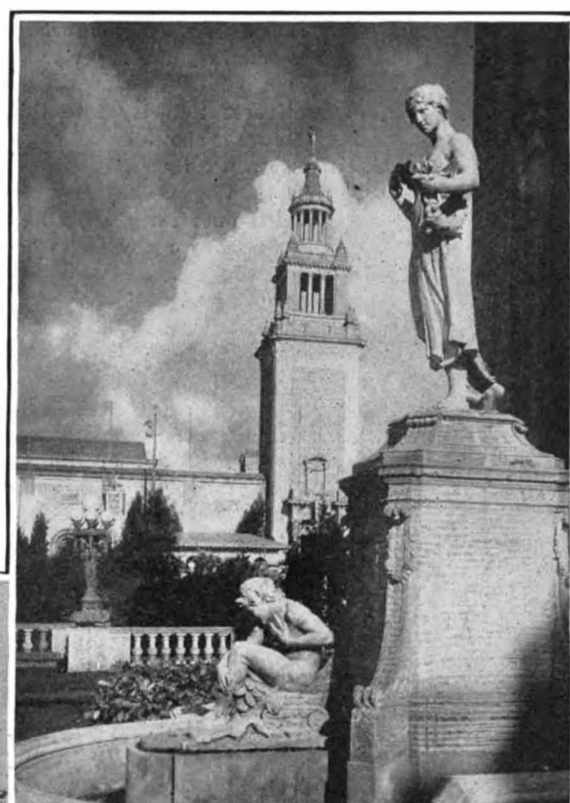
This special feature, that gives a startling beauty and brilliancy to the entire scene, is the introduction of color, not for an occasional contrast, but everywhere, and making the whole scene poly-chromatic. We know that the Greeks in their most beautiful creations did not rely on form alone for their effects, but used colors liberally, not only in their architectural work, but in their sculpture, and this is the plan adopted at San Francisco. Early in the preparation of the plans the management called in Jules Guerin. He has wrought on this six hundred and thirty-five acre canvas a harmonious picture, vivid in color and beauty. In contrast with other similar undertakings there are here none of the great familiar areas of white showing up on every side, for white has been entirely eliminated from the color scheme everywhere. In its place we have the marvelous blending of brilliant shades of red, orange, and blue with the green of the trees and shrubbery and the soft, warm buff of the walls of the buildings, for this shade has been adopted as the universal tint for all of the large blank surfaces. The many domes are gold and copper green, while the roofs show in some places the old red Spanish tile, while others are cerulean blue. The capitals and friezes are picked out in gold, blue, and orange, while the colonnades show pleasing contrasts of warm buff against Pompeian red.

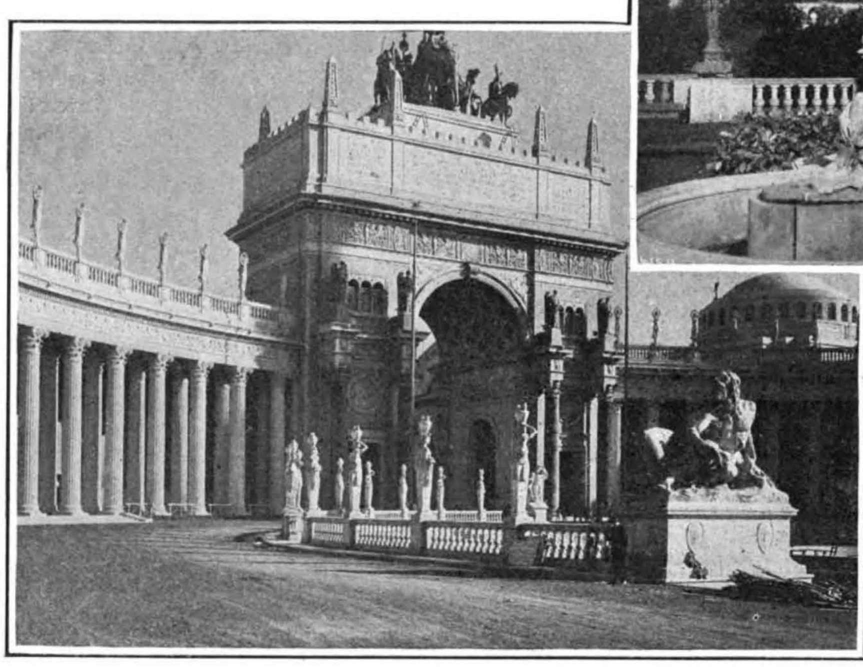
These colors are not applied as paints or stains, but as pigments mixed with the material of which the surfaces of the buildings are composed; and this is of the character of cement rather than of the once familiar "staff," for which reason the colors are not as easily or as quickly affected by the weather. Furthermore, the surfaces have a natural stipple character that softens the color effects and eliminates all disturbing reflections. Cunningly arranged in the decorations of capitals, and in the flutings of columns, are numerous electric lights, which, with the many searchlights distributed about the grounds, illuminate the buildings at night and startlingly bring out their beauties.

Sculpture is freely and effectively employed everywhere, and this branch of the decorative work was in charge of Karl Bitter and A. Sterling Calder, while the various notable works were created by many well-known artists. Monumental fountains are located in the various courts, and many spectacular groups are found surmounting the arches. Mural paintings, skillfully rendered in harmony with the general color scheme, have been appropriately located and distributed.

Considered as a whole this fair is an object lesson of the greatest value to every architect, artist, or other student or lover of the beautiful in color and form.

In its exhibits the great progress that has been made in every branch of art, science, manufacture, and industry should insure an array of novelties to satisfy the most exacting; and the management gives assurances that this is the case. Naturally the war has had its effects, but apparently this will not be appreciable, especially in view of the fact that even since the war started several of the nations involved have increased the appropriations made for the purposes of their displays, and even desolated Belgium will be represented by notable collections. This same is the general situation in regard to European countries generally; but irrespective of these the contributions of our South American neighbors and the displays from the Orient are probably sufficient to amply reward every visitor for his pilgrimage.





Arch of the Rising Sun with group "Nations of the East."

Fountain of the Festival Hall and the tower of the Court of Palms.

The Tower of Jewels covered with thousands of flashing crystals.

# Doing Without Europe—V

## Some Striking Instances of the Value of Research in Industry

*This article is to be regarded as a direct continuation of that published in last week's issue of the* SCIENTIFIC AMERICAN. *Its object is to set forth the possibilities of industrial research not only in solving the industrial problems created by the war, but in enriching the country in a new way.*—EDITOR.

WHEN one considers the opportunities that confront the American manufacturer and the ease with which many of the problems connected with the establishment of new industries in this country can be solved by industrial research, it is amazing indeed to discover how backward we have been. In the automobile and upper leather manufactures, for example, chromium is of great importance. Most of the ore comes from South Africa, Austria, and Russia. Who knows but a substitute may be found if a competent expert is employed to find it? Cyanide of potassium is made in Germany and is much used in gold mining and electroplating. The war has completely upset the industry. Who will be the first to employ an industrial research chemist to work out a process which will be profitable in America?

Ichthyol, a peculiar asphaltic material found in Austria, which finds application after appropriate chemical treatment as a very important medicament, has been cut off almost entirely. The raw material comes from a fossiliferous deposit near Seefeld, in the Austrian Tyrol. It is carefully selected and subjected to dry distillation. The distillate thus obtained is then sulphonated and subsequently neutralized with ammonia. The use of this material has greatly increased in the last few years. Since the beginning of the war its price has doubled. Already a firm in St. Louis has a material on the market which has been favorably recommended as an efficient substitute closely resembling ichthyol itself.

Chemical glassware has gone up markedly in price since the war. There is nothing mysterious in the making of glass—at least there ought not to be. But our glass industry, with the exception of plate glass, is in a low condition. That is because it has never been scientifically conducted. Its processes are still based upon formulæ handed down from father to son. Often as many as twenty-four different ingredients are mixed together to form a batch of glass-making material, notwithstanding the fact that, scientifically speaking, only four are required. In glass-making alone there is an enormous opportunity for industrial research since the war began.

There is one carbon that is manufactured in Europe that is superior to the American carbon, and that is the projector carbon used for moving-picture machines. The American manufacturer has not been able to produce a carbon which seems to be as satisfactory for the purpose as the German. The Speer Carbon Company of St. Marys, Pa., is conducting research which probably will produce a carbon that will ultimately compare very favorably with the equivalent European product.

### One Effect of Prohibition in Russia.

When Russia placed a ban upon vodka it little realized the industrial effect. Fusel oil is a by-product in the manufacture of vodka, and fusel oil is necessary in the making of lacquers. Hence, the lacquer supply at present in this country must be carefully guarded. Now, it happens that about two years ago the E. I. du Pont de Nemours Powder Company made a very careful and exhaustive study of the synthetic manufacture of amyl acetate and refined fusel oil, and succeeded in developing a process by which both of these materials can be made synthetically. Fusel oil is a by-product of the distillery, and in the past has been allowed actually to run to waste. Because of a corner engineered by a Russian syndicate, the price was greatly advanced two or three years ago; but there was no legitimate reason why the cost in this country should exceed $25 to $35 per 100 kilos. At this price it is not possible to compete with the synthetic article.

If we were to enumerate all the possibilities that have been opened up by the war, we would have to publish an article which would require page after page of the SCIENTIFIC AMERICAN. We do not advocate industrial research as a panacea for all our industrial ills; nor do we believe that it will answer the requirements of every manufacturer. On the other hand, it is safe to say that the helplessness of most business men in face of an industrial situation which is one of the severest that they have felt for many years could be removed if expert advice were sought.

### After the War—What?

It must not be forgotten that, if their plants are not damaged in the present war, German manufacturers will put forth the most strenuous efforts to regain their trade with outside markets. The loss which has been sustained by the interruption of their manufacturing operations must be recouped, and the United States with its low tariff would be a shining mark for these commercial attacks. What little headway we have made in foreign markets will probably also be lost; for in foreign markets we have always been helpless when we met the competition of the Germans.

Now, the Germans' strongest asset is industrial research. The smallest German manufacturer knows how significant it has been in the upbuilding of Germany's industrial power. He knows exactly where he is weak, and proceeds to strengthen his business with the aid of the Material-Prüfungsamt of Gross-Lichterfelde, near Berlin, and of dozens of private institutions which are scattered throughout his native land. Apart from any patriotic desire to do without Europe, it will become vitally necessary to the American manufacturer to take more than a passing interest in industrial research if, after the war, a flood of German goods will inundate this market at prices even lower than those with which American manufacturers had to contend before.

Once the American begins to take a healthy interest in the scientific improvement of his manufacturing processes, we will find him as restless in that respect as he has been in developing the mechanical efficiency of his plant. He will change his whole attitude toward manufacturing.

### The Folly of Trade Secrets.

In the first place, he will care less about trade secrets than he now does. Even now the industry dependent on trade secrets is fast giving place to the industry that is scientifically conducted. The dye house of a textile mill is a case in point. There was a time when the master or "boss dyer" had a special knowledge which he guarded carefully. He was on close personal terms of intimacy with his several helpers, the most ambitious of whom ultimately and in turn became a "second hand" and was taught the principles of the trade—in reality, the "drugs" utilized and how prepared for dyeing. When Perkin discovered mauve, a new era dawned. The secrets of the dyers have given place to the great amount of practical technical data disseminated by the large color manufacturers. As a technically informed person, the dyer of to-day is infinitely the superior of the boss dyer of yesterday.

The introduction of the glucose industry into this country is also interesting because it shows how secrecy gave place to science. In a measure the industry was an imported one, as Mr. T. B. Wagner of the Corn Products Company once pointed out; for glucose had been made from potatoes in Germany many years before the establishment of the first factory in this country. In those early days it was necessary not only to import the machinery, but skilled labor as well. Among the most important were the men in charge of the vacuum pans. They were brought here at the expense of the manufacturer and engaged at extravagant salaries. They were quick to realize their advantage and soon became the bosses of the plant. They ruled absolutely. Their work was surrounded with great mystery, but it had to give way to efficiency, and to-day the position of a pan man is no more important than that of any other workman; in fact, unskilled men are often selected for this work and soon become experts at their post.

### Wealth from Waste.

In the reclamation of industrial wastes alone—the truest kind of conservation—an immense amount of profitable work remains to be accomplished. The glucose industry is an object lesson in that respect. One of the last by-products to be recovered in that industry was the so-called "steep water"—the water in which the corn is immersed and softened prior to grinding. In the words of Mr. T. B. Wagner: "It contains the most valuable ingredients of the grain, namely, the organic phosphorus compounds, magnesium and potash salts, nitrogenous bodies and sugars. Many efforts have been made to recover these solids in dry form, but owing to the hygroscopic condition of the residue, such methods were found to be impracticable. At one Iowa factory grinding about ten thousand bushels of corn per day, the steep water was run with the wash waters from starch and gluten into a creek, which in turn discharged into a river of fair size. This method of disposing of the steep water soon became a menace to the plant, and court suits were started against the factory, since the fish were killed and the residents were discomfited. The owner of the factory was compelled to run a pipe line to a farm located about three miles from the factory. For that privilege, besides furnishing a most excellent fertilizing material, he had to pay the farmer $3,000 annually. To-day this form of waste is recovered by collecting it, concentrating *in vacuo* and adding it to the gluten seed in the form of a syrup, with which it is subsequently dried, the seed acting as an absorbent. Instead of investing in pipe lines and paying for dumping rights, the waste of a 10,000-bushel plant was thereby converted into a revenue of almost $100,000 a year. Applied to the industry as a whole, this form of waste furnishes to-day an annual gross income of approximately one and one half million dollars."

The utilization of waste lyes of industrial plants has always been a difficult problem. The question is pressing for cellulose plants working according to the sulphite process. The waste liquors of these plants contain, in addition to sulphurous acid, about 10 per cent of wood pulp in suspension, which has been simply allowed to run off with the waste water. Because of the sulphurous acid, the lye is biologically detrimental to water courses, and has given rise to damage suits as well as complaints. In addition, the air in the vicinity is badly contaminated.

In Sweden the waste liquors are used in the production of alcohol. In Germany this was not economical, and accordingly a process was developed in a Rhine plant for obtaining a useful solid product—a transparent, resin-like substance, which can be utilized as a binder in coal or metal briquetting, for which purpose it is said to have an advantage over coal tar pitch. At a plant in Bruckhausen, 18,000 tons of blast furnace dust are daily transformed into briquettes with this cellulose pitch.

### How Old Problems May Be Profitably Solved.

As far back as 1872 chemists had hinted that perhaps there were industrial uses for what they called "phenolic condensation products," which were modified forms of carbolic acid. But resin-like substances were formed in obtaining these phenolic condensation products, and no one knew what to do with them. Dr. L. H. Baekeland, a well-known industrial chemist, set to work and discovered how they could be controlled. From carbolic acid and formaldehyde, two ill-smelling substances, he produces an absolutely new compound—a solid, hard, infusible, insoluble compound which might easily be mistaken for amber or fine Chinese lacquer. Cigar holders, battleship switchboards, jewelry, acid-pump valves, brass bedstead lacquers, phonograph records, billiard balls, automobile magnetos, unbreakable dolls, newspaper stereotyping matrices, and much electrical machinery is made with his transformed carbolic acid. He has given America a new industry.

An equally notable solution of a technical problem which had long baffled other investigators is the Frasch process for refining the crude, sulphur-bearing Canadian and Ohio oils. The essence of the invention consists in distilling the different products of the fractional distillation of the crude oil with metallic oxides, especially oxide of copper, by which the sulphur is completely removed, while the oils distill over as odorless and sweet as from the best Pennsylvania oil. The copper sulphide is roasted to regenerate the copper. The invention had immense pecuniary value. It sent the production of the Ohio fields to 90,000 barrels a day, and the price of crude Ohio oil from 14 cents a barrel to $1.

### The Money that Research Can Make.

The effects that may be produced by even slight improvements almost surpass belief. Gayley's invention of the dry air blast in the manufacture of iron involves a saving to the American people of $15,000,000 to $29,000,000 annually. A modern furnace consumes about 40,000 cubic feet of air per minute. Each grain of moisture per cubic foot represents one gallon of water per hour for each 1,000 cubic feet entering per minute. In the Pittsburgh district the moisture varies from 1.3 grains in February to 5.94 grains in June, and the water per hour entering a furnace varies, accordingly, from 73 to 237 gallons. In a month a furnace using natural air received 164,500 gallons of water, whereas with the dry blast it received only 25,524 gallons. A conservative statement, according to Prof. Chandler, is that the invention results in a 10 per cent increase in output and a 10 per cent saving in fuel. It has been estimated by a well-known research electric engineer that the metallurgical improvements in transformer steels, brought about within the last few years by modern metallurgical research, represent a saving in money which would amount, if capitalized at 6 per cent, to approximately $15,000,000, is the experience of one great manufacturing corporation alone.

# The Government Ship Purchase Bill—II

## The Fallacies of the Administration's Policy

By Senator Theodore E. Burton

DURING all the lengthy and momentous period during which I have been privileged to be a member of the Senate, I cannot recall any proposed legislation, which, having regard to its great importance and far-reaching consequences, was so hastily conceived and ill-begotten as the Ship Purchase Bill of the present Administration. The very first reading of the bill brings up a dozen questions to not one of which is a satisfactory answer given or even suggested.

First of all is this policy to be permanent or is it to be temporary? If it is to be temporary one set of reasons would apply. If it is to be permanent another line of policy should be adopted. I find that the statements of the sponsors of the bill on this phase of the subject are at variance. Thus, in an address at Boston, the chairman of the House Committee, Mr. Alexander, said: "The Government ownership bill is spoken of as an emergency measure. It should not be so called. European governments have in the past laid the foundations of their merchant marine by government protection." Yet on the previous day, Senator Fletcher bringing forward this bill in the United States Senate said: "Without going further into the details of this bill, I assure the Senate in the first place, and the country, that it is not a permanent business undertaking of the Government that is intended here." And yet again, the President in his message in December said: "It is not a question of the Government monopolizing the field. It should take action to make it certain that transportation at reasonable rates will be promptly afforded, even where the carriage is not at first profitable, and then, when the carriage has become sufficiently profitable to attract and engage private capital and engage it in abundance, the Government ought to withdraw." Now here we have two distinctly contradictory statements. Which are we to take as authoritative?

Is this to be an enterprise for profit or not for profit? Is it supposed that by running at a loss for a period, in some mysterious way the business would become profitable as implied in the President's message and that the Government would then be able and willing to turn it over to private hands? It is self-evident that such a supposition is without any foundation in reason. The sure results of the Government operating merchant ships at a loss will be the complete demoralization of the shipping trade, the destruction of such merchant marine as we now have, and a long postponement of the day of its revival. Furthermore, when the measure was first brought forward, it seemed that what was under consideration was trade development in South and Central America; new avenues of trade, "empty markets" to use the expression of the President, "were the objects in view." Now there is an entire change and the advocacy of the bill is based upon the necessity of sending freight to Europe.

Now what are the facts with regard to this South American trade? We find that ten boats leave every month on the average from New York for Rio de Janeiro on the east coast of South America. Before and since the war they have been running with a surplus of cargo space, sometimes being only half-filled. On the west coast of South America, notwithstanding the stimulus afforded by the opening of the Panama Canal, the Peruvian and Chilean Navigation Companies, which jointly ran boats weekly, have withdrawn the weekly service and made it fortnightly.

I am sorry to say that there are a great many people in the United States who do not seem to realize that we are in the midst of the most titanic conflict between nations that the world has ever seen. We should have a deep realization of what it means. Certainly we should not at this time allow fondness for the enlargement of trade—a disposition with which I sympathize—to erase from our minds a realization of what this war means and of the duty of the American people. I want the American people to realize this fact: There is war, and this war has deranged the routes of trade. It has destroyed many of the agents of transportation. It has diminished shipping facilities. It has introduced demoralization, partial destruction, in almost every branch of commercial and industrial activity. We must not ignore that fact. Certainly we must not treat this question as if it was one to be settled as if we were now at peace.

Will the conditions of European trade be relieved by increased shipping? Do not let us deal with generalities. Let us get down to the facts. What is it that has caused this decrease in the supply of shipping and an increase in freight rates? In the first place German and Austrian shipping, carrying probably about 14 per cent of the foreign trade, is withdrawn from the seas. But let us consider that for a moment. If German and Austrian shipping is withdrawn, so also are Germany and Austria shut off from the trade of the world. The Baltic Sea and the Black Sea are both practically closed to trade; and roughly approximating an estimate we may say that the trade of the world has decreased because of the war in just about a like proportion to the decrease of available shipping.

Another factor of great importance is the liability of boats to search and seizure. Still more important is the cost of war risk insurance. Another factor is the dangerous channels through which shipping may go, confronted as it is by the fearful menace of the high explosive mine; and yet another factor is the requisition, especially by Great Britain, of a good share of its shipping to be used for military purposes. Finally and most decisive of all elements in the situation is the delay in foreign ports due to congestion.

Regarding this last condition, a man said a few days ago—and I am not sure but that he was pretty nearly right—the provision of more ships would add to the congestion, for they are all at present in each others' way in foreign ports. By way of illustration I mention the case of an American boat chartered to carry horses to a port in France, which had an additional cargo capacity of 8,000 tons dead weight. Upon the owner's learning that in the port to which they were going there had been a delay of 60 days in loading and unloading, he dispatched the ship without filling a foot of the space, rather than take the risk of delay and detention. A few days ago 30 ships were waiting in vain at Genoa to be unloaded. There is similar congestion at Liverpool and London. It is evident that should the Government purchase $40,000,000 worth of shipping to be used in the trans-Atlantic trade (and this as I have shown is the latest proposition of the Administration) these vessels must be subjected to all the disabilities incident to the present disturbed condition occasioned by the war, to which I have referred above.

But where is the Government going to obtain its ships? A leading shipping authority who has been quoted by the Secretary of the Treasury says that there are not more than ten ships available under neutral flags that would be suitable for the purpose, and he therefore advises the building of new ships. Very good; but we are told that it is a "present emergency" that is upon us. Nevertheless we all hope that this war will close in less time than ships could be built. Most of our shipyards are busy already and it would be 10 to 16 months before a boat of any considerable size, suitable for trans-Atlantic trade, could be built in one of our shipyards. In the meantime we have those ten ships. What is the Government going to do with them? What better would the Government do with those ten ships than the private owners are now doing? Is the Government, which we must concede is sometimes very unwieldy, going to manage the shipping business better than the private owners?

Although Government ownership has not the terror for me that it has for many, it must be borne in mind that in the proposed bill it is partial Government ownership which is advocated, although there is nothing surely more disastrous than to have part Government and part private ownership. This is not a fair test of Government ownership and operation. Furthermore, the ships purchased with $40,000,000 would be a mere bagatelle in the shipping of the world. Even if it were half the world's shipping, the country would be in about the same condition as the citizens are when there are two telephone lines in their city. We have all heard the statement, "You have one telephone line here. If you put in another you will have the benefit of competition." We are all familiar with the results; separate wiring in each building; separate conduits in each street, two telephones in each office; inconvenience all along the line, and finally either insufficient service, or the public has to pay the interest on both systems.

Supposing that this Government-private corporation scheme possesses itself of one fourteenth or one twentieth of the shipping of the world. What is to be its policy of operation? Will special ports be selected? If Galveston is chosen, will not Mobile and New Orleans complain? If a special product such as wheat or cotton is chosen as freight, every other class of producer will complain that the Government is giving a special advantage to this line of business. Suppose the Government carries at lower freight rates than private owners. What would be the result then? Simply that one twentieth of the traffic of this country—certainly not more than one tenth—will be carried at a lower rate. What is the result? Does the great body of the American people get the benefit of it? No. It is the few who are benefited by those rates. It is impossible for the Government or for anyone to go into this shipping business partially and make a success of it. If the country is to go into Government ownership it is necessary that the United States shall control the whole business. There is no middle ground.

I fear that there is no general recognition in Congress or outside of it of the fact that the shipping business is one of the most complicated and difficult of all industrial activities; and that it calls for long experience and a thorough acquaintance with the conditions on the part of those who wish to enter the field with any hope of successful competition. I recognize the disposition on the part of many of the American people to disparage expert knowledge. It is thought that inexperienced men may gather round the table and smoke cigars and make plans and devise organizations for the trade or industry just as well as those who have given their lives to it.

Now the shipping trade has been developing for centuries. It has adopted new routes of trade, new methods. There are certain necessities in regard to it. There must be terminals for the loading and discharge of freight. It is not sufficient to have ships; there must be wharves and piers. Is the Government going to secure these also? There must be affiliation with shippers; is the Government going to secure such in a month or two months? There must be a familiarity with the routes of commerce. A most careful calculation must be made so that the ship will not only have an outgoing but a return cargo; that she shall have something to do the year around.

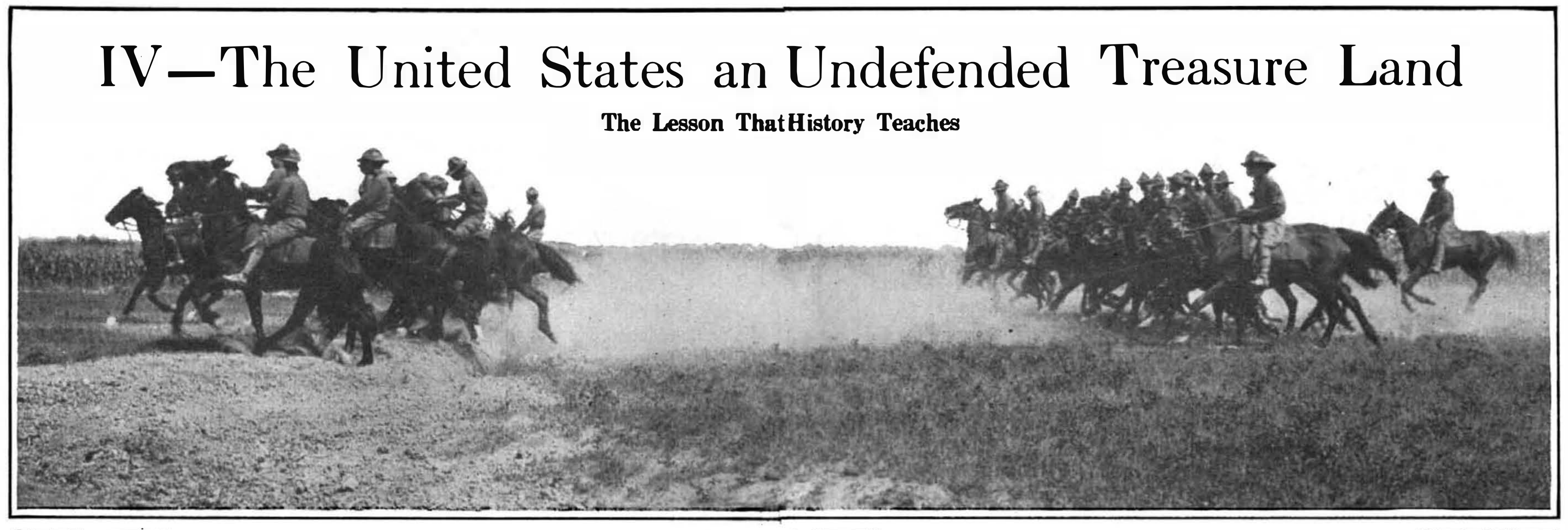
Then there is that serious question of the purchase of the ships of belligerent nations. The doctrine of the continent of Europe is that the transfer of a belligerent ship to neutral flag in time of war is void, and that if she sails with the neutral flag, she can be seized, taken into the prize courts and condemned. This continental doctrine was agreed upon by all the commercial nations, practically, in convention in London in 1909. With all these belligerents united in the idea that ships cannot be transferred under these circumstances, I want to state that we cannot afford to take the chance, particularly if it is borne in mind that no nation has insisted upon the rights of belligerents more earnestly than we did in the civil war. And just here it cannot be too strongly emphasized that this is not a private enterprise. Instead of buying the boats directly the Government is to organize a corporation, 51 per cent of the stock of which is to be paid directly from the Treasury, and if the remaining 49 per cent is not taken by private subscription then the Government takes that also. The Secretary of the Treasury and the Secretary of Commerce exercise certain supervision over this corporation with three others who constitute a shipping board. We have been informed that the President is to have control of this enterprise. But what I ask is, How is that policy consistent with private business of a private corporation? The fact of the matter is that this corporation is a mere mask. It is a Federal enterprise. Now a citizen can ship munitions of war to a belligerent and the Government is not compelled to intervene. If the citizen's boat is caught, he loses that which is contraband in his cargo; but the moment the Government of the United States does a thing of that kind, it is an act of hostility leading to the most serious complications. You cannot get out of that situation by passing a bill of this kind and going through the fiction of organizing a corporation of the District of Columbia.

It is simply preposterous to believe that a Government Board entering into this business without affiliation with the shippers, without wharves and docks, can utilize those boats and carry any more freight on them than the private citizen who has made it a business all his life. The scheme is foredoomed to failure by the very economic necessities of the case, and if it should be once set afloat and include the purchase of belligerent ships, the United States will be very fortunate indeed, if in addition to a pitiable financial failure, it does not find itself with a serious international quarrel upon its hands. I should tremble with apprehension if this corporation should be organized, and the boats owned by it, under the direction of the Government, or as Secretary McAdoo has said, under the general direction of the President of the United States, should go out to sea and be seized by England or Germany on the ground that the cargo was contraband or that the ship had been transferred to our flag by a belligerent in time of war. I for one certainly do not want such a bone of contention, such a source of friction and quarrel brought into our international relations at this time, when everything is so tense

(Concluded on page 204.)

# IV—The United States an Undefended Treasure Land

## The Lesson That History Teaches



*[The peril of invasion, the necessity for being prepared to meet and repel it, the certainty of overwhelming national disaster and disgrace if we stay as we are, are immeasurably greater to-day than when Washington, Adams, and Jefferson urged upon the United States the necessity for maintaining armed forces for the protection of the country. In those days war gave ample notice of its coming, and there was time to make emergency provisions to meet its gradually accumulating pressure. To-day war falls like a thunderbolt from heaven and the first blow is often the decisive blow.*

*For a nation which, like our own, is totally unprepared, a modern war is won almost before it is begun. Every solemn warning uttered in the preceding, and in this the final chapter of this series, is based upon absolute facts, and he who tells this country that an effective army of defense can be raised between sun and sun is his country's worst enemy. The words of Washington are as true to-day as when they were spoken: "To be prepared for war is one of the most effectual means of preserving peace."*—EDITOR.]

Copyright by International News Service

In the advanced trenches at Vera Cruz.

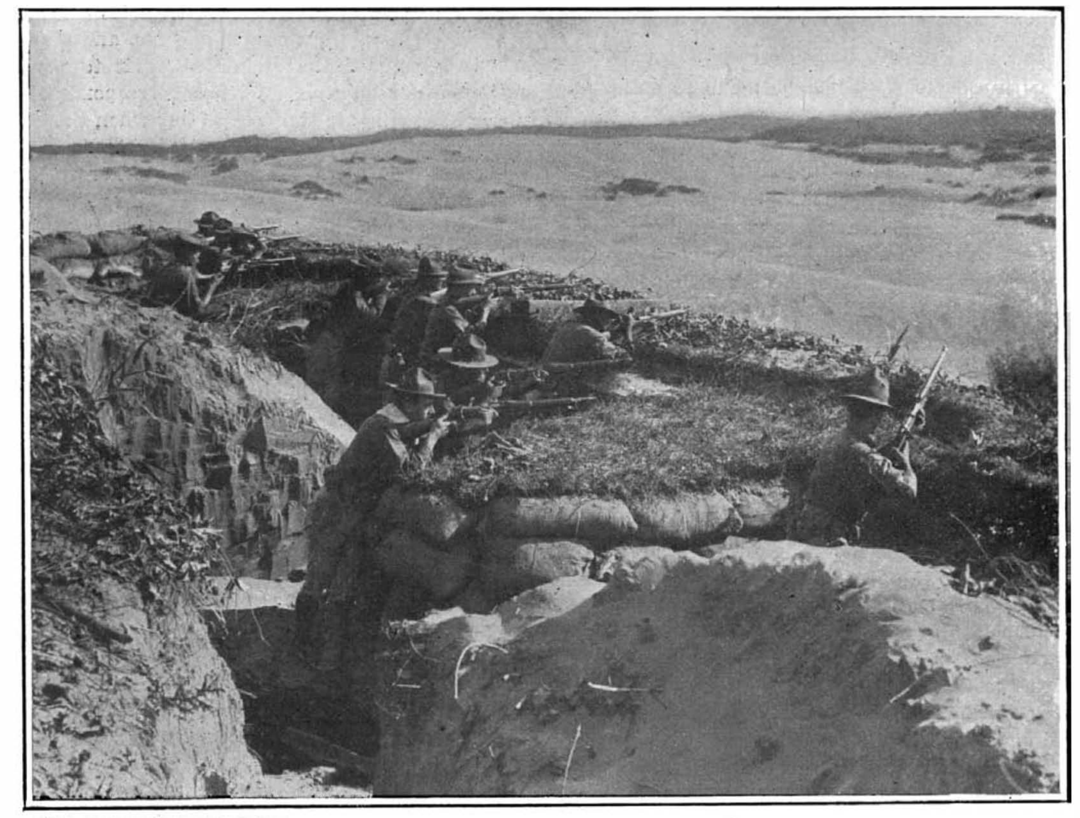


Photo. by International News Service

Entrenched troops repelling an attack.

AT the end of the Civil War we had, North and South, about three million effectives who had seen actual military service. In other words, we had a splendid unorganized reserve, out of which first-class armies could have been made on short notice; we had a very strong navy, and immense reserves of guns and other munitions of war. All these men have gone. The guns are obsolete, and we are now, with greatly increased responsibilities, absolutely without reserves, and with a regular army and militia which are, in effect, only a handful of men.

### False Estimates of Our Military Prowess.

We have never had war with a first-class power prepared for war, which we have fought unaided. During the Revolution, the English opinion concerning us was divided, and at a critical stage of the war we had the invaluable assistance of France. In the War of 1812 England was engaged in the death grapple with Napoleon, and the largest number of British regular troops in this country at any one time was about 16,800. In fact, from the military standpoint, we were a side issue. England's energy and effort were concentrated against Napoleon. While we had individual, brilliant, single-ship actions at sea, at the end of the war such ships of war as we had afloat were under blockade, our coastwise commerce practically destroyed, and our commerce on the high seas suspended. We were almost universally unsuccessful on land up to the Battle of New Orleans, where for the first time the British met a foe skilled in the use of the rifle and men many of whom had been under fire.

### Moral of the Loss of the Capitol in 1812.

We put into this war 527,000 different men; we abandoned our capitol to a force little more than one half that of the defenders, with a loss of eight killed and eleven wounded, and this at a time when nearly every American was familiar with arms and knew how to take care of himself in camp and field. It should also be noted that the force defending the capitol was made up largely of troops drawn from sections which had furnished some of the best troops of the continental armies. The reason for failure and general defeat on land was because we trusted to untrained, raw levies, men utterly unprepared to meet well-trained troops. The nation was responsible, and showed that it had learned little from the experience of the past and that it was fairly entitled to the criticism of Light Horse Harry Lee, who said in effect, "That nation is a murderer of its people who sends them unprepared and untrained to meet in war men mechanized and disciplined by training."

### We Were Unprepared and Untrained in 1812, and, Relatively, We Are Even Worse Prepared To-day.

The people of 1812 were unprepared and untrained. To-day we are not only unprepared, but are absolutely ignorant of the use of arms; the population has a large percentage of newcomers, who are not deeply interested in our institutions; the possibility of war is many times greater than hitherto; and the nations whom we have to fear are always ready. We are, relatively speaking, less ready than ever before.

The days of small standing armies, of slow preparation, and of still slower transportation have passed. The possible enemies of to-day are fully prepared. They control almost unlimited transport, and once in possession of sea control can land when and where they wish, certain that no well-organized or thoroughly equipped force will be ready to oppose them. The weakness of our military establishment, our total lack of reserves, or trained men, or of adequate reserves of material, are known to the last detail by all our possible antagonists, some of whom have more thoroughly trained reservists in this country than we have immediately available mobile army and efficient militia combined. This is true of both seaboards and for the country as a whole.

### What Australia and Switzerland Have Accomplished.

The solution of our difficulties will be found in the establishment throughout the country of a system of military instructions on the general lines of that which is in force in Switzerland or Australia. Switzerland, with a small population, is able to put 220,000 men in the field in two days and to follow it with nearly 300,000 more in a week, and she has accomplished this through the operation of a system which has cost her only a little over $6,500,000 a year. The effect of this training has been generally beneficial both upon the physical well-being and economic efficiency of the individuals affected, and has increased their respect for law and order, as shown by the comparatively low criminal rate and the orderly character of the people.

Copyright by Underwood & Underwood

A rush forward to man a trench.

### The Reservist Would Patriotically Answer the Call to Arms.

There has been a great deal of opposition to a reserve in this country on the ground that we shall be unable to keep track of the men. People seem to think that the American reservist is going to be a type of shirk, who will be skulking and hiding when needed for military service. Of course, if this is true, the country will be largely defenseless in time of war; but it is not true. We shall have no more difficulty than other nations have. Their reservists have gone back to the great war by tens of thousands, and done so voluntarily, as they were quite outside the reach of their country's authority.

A system of general instructions in the schools, such as is in force in Australia and Switzerland, will result in an increased sense of responsibility on the part of the individual toward the State and the gradual doing away with the idea that, while we all pay the routine taxes of every-day life, we are not under any obligation to pay the tax on which all others depend, namely, the tax represented by service in war. All history indicates clearly that when the citizens of a nation fail to recognize and pay this tax, the life of the nation is run.

### The Immediate Military Requirements for the Defense of the Country.

To sum up briefly what we need: First, are the new organizations for the regular army as shown in the table of organization of the land forces prepared by the general staff; the necessary field artillery guns and ammunition and other reserve equipment. Second, an adequate reserve behind the regular army. Third, the artillery and cavalry organizations, field artillery guns, ammunition and reserve supplies for the militia and the reserve of men in a word a properly balanced militia, with its reserve of men and material. Fourth, a great number of men trained to be officers of volunteers. Fifth, a gradual building up of trained enlisted *personnel* for volunteer organizations, at least sufficient to supply the coast guard troops above referred to and the additional troops needed to bring the combined regular army and militia when at war strength up to a force of at least 500,000.

### Modern Wars Are Brief, and We Cannot Prepare for War When War Is On.

Unless we take to heart the lesson so clearly indicated by the experience of others and prepare in time of peace all this will have to be done, when war comes, in the hurry and confusion of war, and it will be accomplished at a frightful cost of life and treasure and with great attendant humiliation; for this country is not prepared and cannot defend itself successfully against any well-organized force of reasonable strength, landing on its shores, without such loss and delay as would be gravely disastrous. Such a force will take and hold until we can organize and build up a sufficient military establishment to drive it out of any area it chooses to occupy. Idle talk and boasting will have no effect upon its operations.

We should strive to establish throughout the Republic a universal system of military instructions through the public schools on the general lines now in force in Australia or Switzerland. Such a system will be in every way beneficial. It will make the American youth a better citizen physically, morally, and from a patriotic standpoint. It will also greatly increase his economic efficiency through the habits of regularity and promptness, which characterize military training. He will learn to respect the laws, the constituted authorities and the flag of his country. The system of reserves can be maintained very economically and, once established, both militia and regular army can be kept, in time of peace, at the lowest strength consistent with the needs of the hour, because they can be promptly filled up. We can maintain ten reservists for the regular establishment for the cost of one man on the active list. This proportion may not hold good for the militia, but still the militia reservist will be much cheaper to the State than the man who is on the active list of the militia.

### The Utterly Vicious Bounty System.

We must never again depend upon the bounty system.

(Concluded on page 204.)

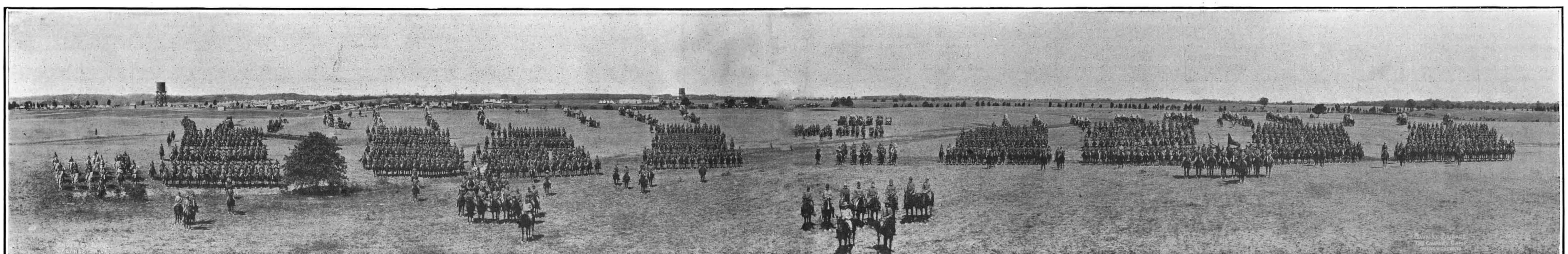


Photo. by Barr Winchester

A CAVALRY BRIGADE—THE CAVALRY CAMP, WINCHESTER, VA.

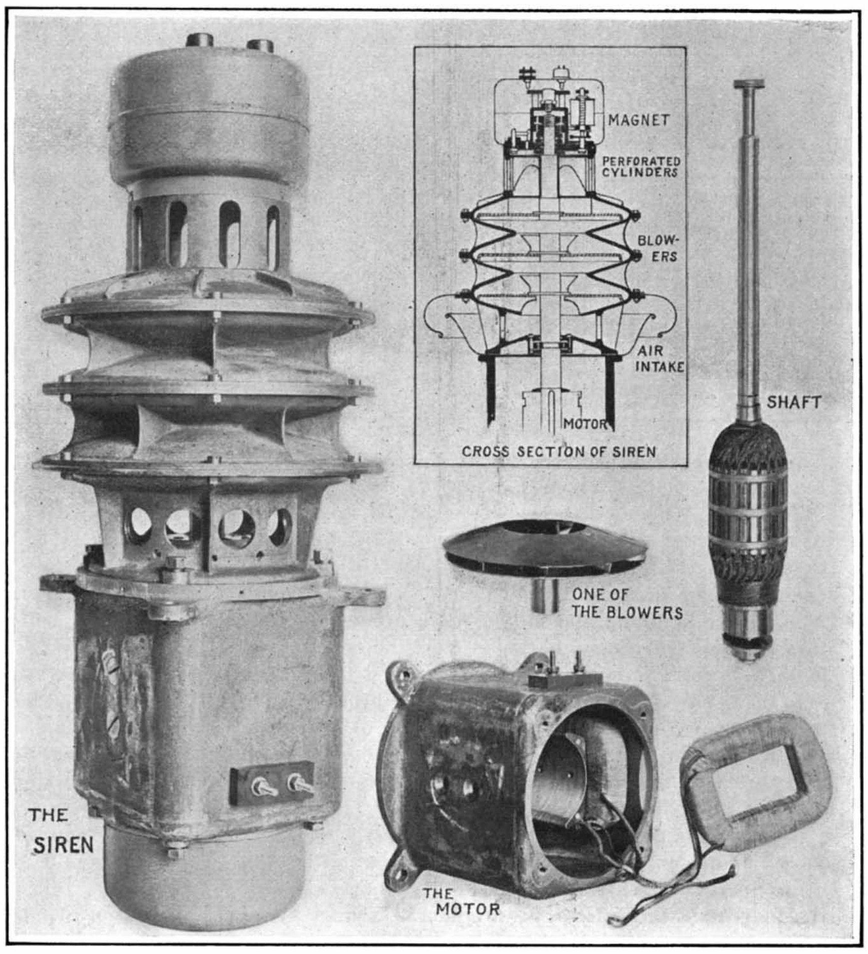
## An Electric Shriek to Warn Mariners

**By Our Paris Correspondent**

A NEW apparatus which is likely to be of great service in signaling between vessels at sea is the Blériot air siren, it being operated by an electric motor, while the sounds are produced in the shape of Morse signals by an electromagnet device. It will serve mainly for making connection between warships or even submarines when in more or less compact groups, and will be valuable for transmitting orders, for it can be distinctly heard at a distance of at least 1½ miles. More reliable than optical signals, for it works in all weathers, it is considered as more practical than wireless telegraphy for this class of short distance operating. The French navy is interested in the matter, and is now engaged upon official trials with a view of adopting it upon battleships. Placed on the top of the mast, the sounds will carry at sea under the best conditions.

Referring to the general view of the apparatus, and also to the section, the siren is designed to produce sounds on the usual principle of an air or steam siren in which the air is propelled through a rotating disk or cylinder working against a fixed one, both containing sets of openings, so that by means of the fixed and movable holes, the air comes out in intermittent jets or impulses, and as the movement is very rapid, owing to the high speed of the revolving piece, such impulses go to form an audible note such as is heard, for instance, on an automobile siren. By varying the speed of the revolving part, low or high notes can be emitted. The Blériot device uses the same principle, but is designed to secure a very powerful sound which will carry for 1½ miles or more. At the top of the device will be seen the portion which carries a set of holes for the passage of the air, and within it rotates a corresponding perforated cylinder so that the air leaves by the sets of holes. in fixed and revolving parts, on the siren principle. What is now desired is to obtain a powerful current of air, such as is needed to produce a very loud sound. This is done by the use of three separate rotary blowers which lie in the three flat chambers seen just below the siren proper and act on the three-stage principle to produce a powerful current. Below these chambers is a set of holes for admitting air. The bottom square part of the device contains an electric motor of upright kind, and the shaft of the motor runs clear up to the top of the apparatus, carrying the three air blowers as well as the rotating cylinder of the siren proper. Thus siren and blowers are all rotated by the same motor.

An ingenious principle is employed here in order to produce a very strong air current for the siren, and, as will be seen in the section, each blower or flat blast fan works inside its chamber in such a way as to take in air at the middle next the shaft and to drive it to the edge by the use of sets of blades as in the usual blast fans, so that the air leaves the edge of the fan at a high rate of speed. The blades are so designed that this speed is higher than that of the rotating blower itself. But above the blower and inside the chamber is mounted a set of fixed blades or wings, so that the air passes up from the edge of the blower and through the fixed wings before it reaches the center space next the shaft. By this means the speed of the air is transformed to pressure. Then the air enters the second blower, and so on to the top, so that when entering the siren the air has a high pressure due to these combined effects. Speed of the motor is 5,000 revolutions per minute. It remains to be able to form the Morse signals by cutting off the air when needed. Between cylinder and outside part is a rotating sleeve which takes the form of a cylinder with holes corresponding to the foregoing. It works to and fro, and serves as a shutter to stop off the air or allow it to pass. Moving the shutter so that its holes correspond with the outside holes, the air can escape, but when the solid parts come opposite, the holes are closed off. At the top is a magnet device for working the shutter so as to operate it by a Morse key. Were the shutter coupled momentarily to the rotating key, it would be drawn forward by friction to the limit of its stroke, then releasing it would allow a spring to bring back the shutter to the off position. This coupling is done by the use of a rod with a small cork washer, which serves as a "clutch" in order to couple the shutter to the rotating cylinder when the rod is lowered, so that the washer touches the inside of the shutter and the flat top of the cylinder at the same time. This rod is worked by the magnet, so that the usual operator's key can produce Morse signals from the siren. Official tests were made with the apparatus before a technical commission from the French navy, and it was found that even under unfavorable conditions of wind and position of the siren, the signals could be taken down anywhere within a radius of 1½ miles using low, middle, and high notes. After using it on land, further tests were made at sea, with equally good results.




**Electric siren for marine use.**

## Equipping the Automobile for Travel

**By Charles Alma Byers**

THERE have been many suggestions made for equipping the automobile for extensive travel, but probably one of the neatest, most complete, and most practical arrangements ever devised for such purpose is shown in the accompanying photographs. This is truly a touring car *de luxe*. And more than that, it has been put to a thorough test, having recently completed a trip of approximately 1,600 miles, extending from Denver to Los Angeles. It made this trip over what is known as the Santa Fe-Grand Canyon-Needles route, carrying a total of seven passengers. Fifteen days were required for the trip, stops having been made at various points along the scenic route, and at no time were the accommodations of a hotel considered necessary. This uniquely equipped automobile consists of a standard chassis fitted with a special body designed under the personal supervision of the owner, H. M. Butts. There is not an inch of space wasted, yet with the baggage, camping supplies and passengers, the machine is not crowded.

On the top the extra tires are carried in heavy cases. There is a compartment behind the back seats in which clothing is hung, as in a closet, and suit cases are stored. The bedding is carried in neat rolls inside the top. The seats make down like a Pullman berth, and there are compartments just above the rear seat where guns, fishing tackle, and other equipment are stored, with pillows and cushions packed in on top. Under the seats four steel rods and two wide strips of canvas are carried. These rods fit into concealed sockets on the side of the car and two sleeping hammocks are swung on outriggers. The side curtains are of extra length, and these buckle down over the guy straps, providing a good shelter.

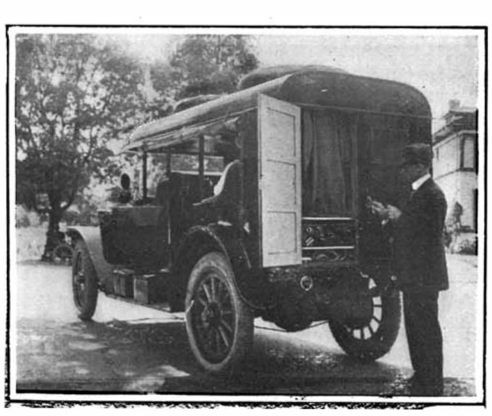
Several planks, rather heavy, are strapped on the right running board, which are convertible into a table on the rear of the car or into a bed, as the occasion requires. There is also a frame which is anchored into the ground with drive pins, and on this it is but a matter of a few minutes to make a comfortable double bed.

With the two side beds, or hammocks, the double bed on the running board, and room for three in the berth inside the car, seven persons are provided with comfortable sleeping quarters. It requires but a very few minutes to transpose the car of the road into a complete camp for the night.

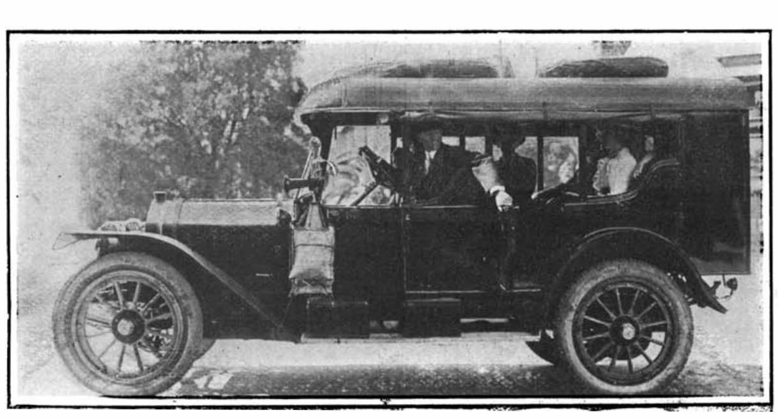
The car is electric-lighted throughout. In every place conceivable there are small compartments for various necessary articles, and the curtains, besides being utilized for covering the hammocks at night, offer protection from rainy, windy, or extreme hot weather while traveling.

## The Current Supplement

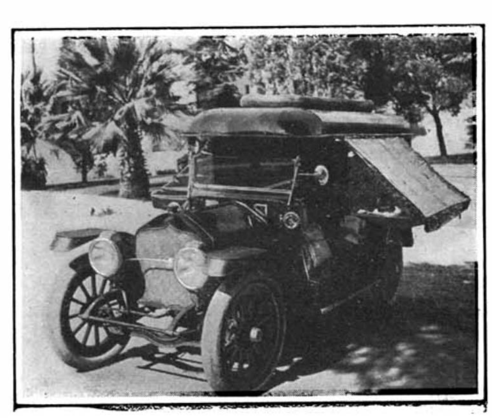
IN the current SCIENTIFIC AMERICAN SUPPLEMENT, No. 2043, for February 27th, 1915, an article on Roman Technics and Industry in Early Germany describes a condition of affairs similar to those claimed to exist at the present time between Germany and her neighbors, and suggests the origin of many of Germany's industries. Biochemical Systems and Their Functions in the Development of Organism deals with important questions of internal functions influencing natural selection. A Physiological Puzzle discusses curious cases of hypnosis and catalepsy in insects, animals, etc., and is of intense interest to all engaged in biological study. The Spinning of a Web describes, step by step, the actual construction of a spider web, showing the wonderful engineering instincts of the insect. A beautiful series of illustrations accompany the article. Standardizing the Art of Voice Production deals with the fundamental principles, and the recommendations of the recent New York State Vocal Congress. The Chemistry of the Incandescent Gas Mantle tells of the principles and the processes in the making of this familiar light. The Artificial Production of Pearls tells how the Orientals induce the oyster to work according to their wishes. Color Photography reviews the history of this branch of photographic art, and describes modern methods. The article on treating gas from furnaces is concluded, and there is a good practical description of how to make a complete Oxy-Acetylene Welding Outfit. There is a page of notices of new and valuable books recently published, together with a number of short, but interesting notes.



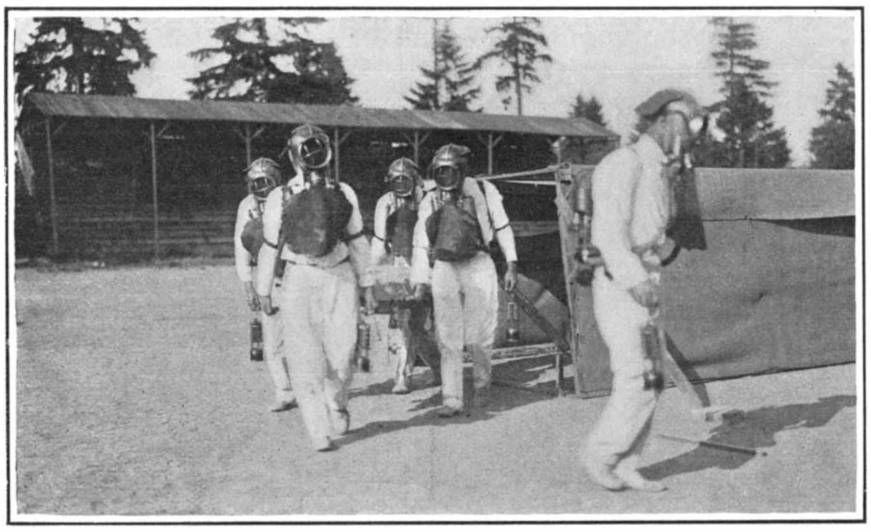
Cabinet containing clothes and suit cases.



Appearance of the car when ready for the road.



One of the side hammocks in use.



Bringing in the victim, the team equipped with oxygen helmets.

Giving artificial respiration for two minutes was one of the requirements.

**Mine rescue contests at the University of Washington.**

## Mine Rescue Contests

IN the State of Washington a team of miners equipped with oxygen helmets represents the town in the State-wide contests that have of late years become an annual affair. The last First Aid and Mine Rescue Contest was staged on the campus of the University of Washington, Seattle, and prizes were given to the winning teams.

A large dummy mine shaft was built before the convention and the various teams brought their own equipment for the contests. Six events were held on each of two days. In the team events, each town or mine was represented by six men: a captain, four men to do the actual work, and a man to represent the victim, who was obliged to submit to bandaging and artificial respiration for two minutes. Arms, legs, back, and face were bound up after the "rescue" while the pulmotor was being applied, and the team that fulfilled the requirements in the shortest time won the event.

An exhibition was given to show how a rescue team would work under special circumstances. A man was slid into the dummy shaft and rescued, the team pretending that he had gone in too soon after a shot and had been overcome by fumes from the exploded powder. Another event was the rescue of the man during a shaft fire. Before the team could leave in good order it was necessary to seal up the burning shaft. The United States Bureau of Mines supervised the contests.

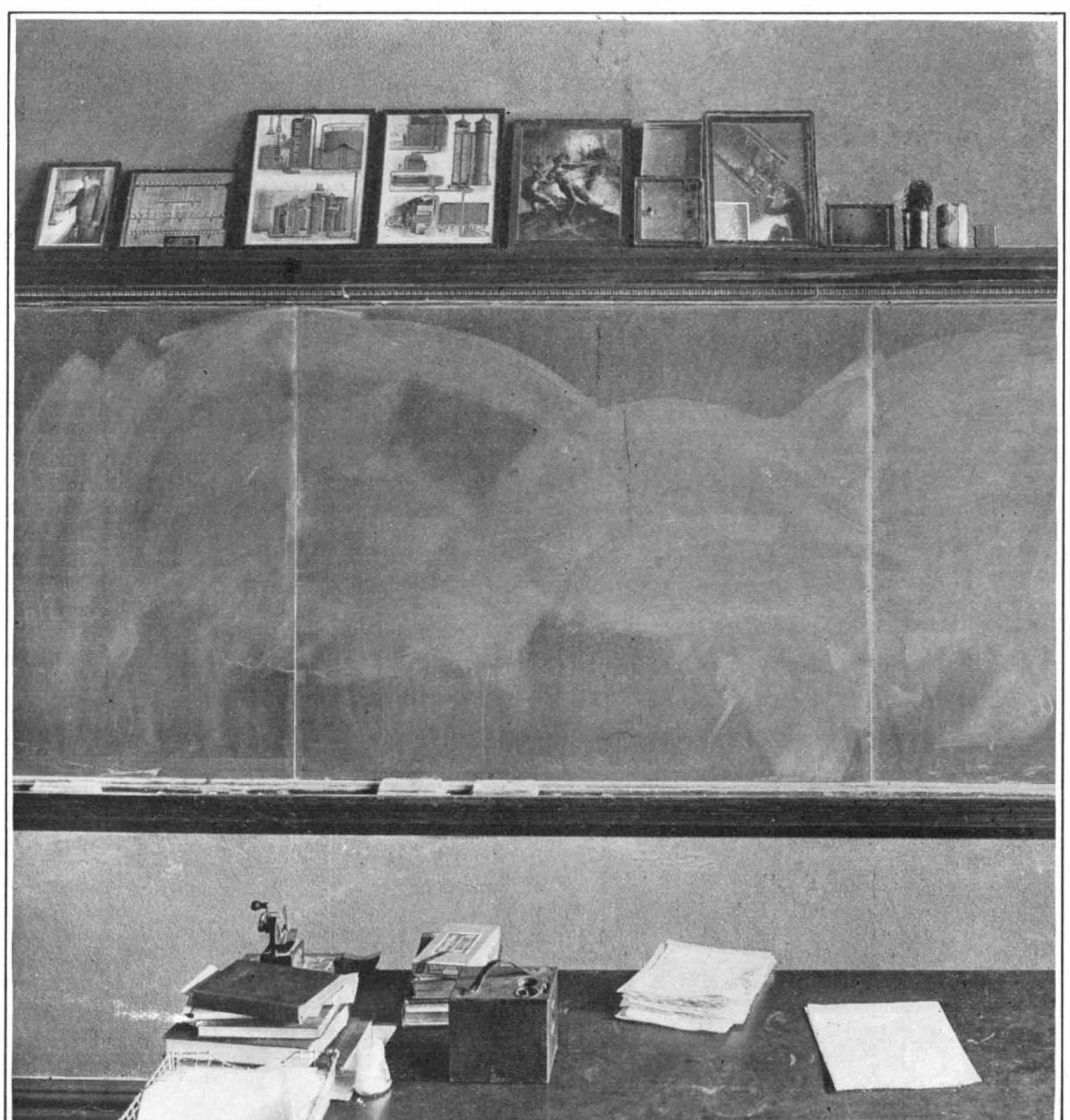
## How to Use the Scientific American

A TEACHER of chemistry in a Minneapolis high school has found good use for the SCIENTIFIC AMERICAN in her classes. The accompanying photograph of the front of her recitation room shows how she preserves and uses "some of the great amount of helpful material the SCIENTIFIC AMERICAN gives for high school work in chemistry."

The exhibits above the blackboard are, from left to right:

1. Dr. Wiley.
2. Chart showing derivation of the chief chemicals and manufactured products from the raw materials.
3. Water gas. (From the SCIENTIFIC AMERICAN.)
4. Coal gas. (From the SCIENTIFIC AMERICAN.)
5. Drawing the charge. (From the SCIENTIFIC AMERICAN.)
6. Tin model of "purifying box used" in making coal gas.
7. The equatorial. (From the SCIENTIFIC AMERICAN.)
8. Polar star trails. (Photograph by a senior boy.)
9. Charcoal from sugar.
10. A gaudy toilet soap—a souvenir of a visit to a factory.
11. A silvered mirror—laboratory work. All of these stay in front of the class all of the time, and credit is given the source as each is taken down and used.

Lantern slides have been made of Nos. 3 and 4, and these two form the basis of a 45-minute lecture to each of four classes each semester—a summary of previous discussion—a final preparation for the visit to the gas plant.



**How the "Scientific American" is used in a high school chemistry recitation room.**

## Constructing Selenium Cells

WE have already given a few practical hints about preparing a base for selenium cells from slate or other material, and would now say a word about how to wind the base with platinum wire. Constructors who make a business of producing selenium cells will not employ any other metal than platinum, as other metals are said to be affected by the contact with selenium. This will, of course, alter the electric resistance and make the cell variable with time and generally bad, while with platinum no such effect is seen, as is besides attested by the brightness of the platinum, while copper when removed from contact with selenium, is seen to have a black surface. In procuring platinum wire, care should be taken that it is reeled off upon a spool, and not wound off as one would naturally do by hand, for this results in twisting the wire at each turn, and it thus has weak places which are almost sure to break afterward, to the great detriment of the work. The same holds good in winding it off from one spool to another by the amateur. A good method of handling is to use a common spool and screw it down to the table, then by loosening or tightening the screw it can be wound or unwound, for instance in cleaning the surface, which should be done by chamois skin wet with alcohol to remove grease, then flaming the wire in a Bunsen burner. This is a useful precaution to be sure that all impurities are removed. Subsequent handling of the wire should be done by paper to avoid touching with the fingers.

The wire is fastened to the base by wrapping it around a few times through one of the two small holes that are drilled in each end of the slate base, then with about a yard of wire off the spool, the cell is turned about in the hands so as to do the wrapping in the grooves, always keeping the wire taut as one approaches the spool; then by unscrewing, another yard of wire can be released. When the cell is full, the end of the wire is fastened by wrapping in the hole at that end of the slate. Naturally every other groove is left free, so as to wrap on the second or parallel layer of wire in the same way. By proceeding in this way, the wire is never twisted, and breakage of the platinum is avoided as much as possible. Before coating with selenium, the cell should be kept in a tight box and quite free from dust.

---

**Capt. Brussilov's Arctic Expedition,** which left Petrograd in July, 1912, and endeavored to effect the Northeast Passage to the Pacific, is lost somewhere in the Arctic Ocean and may be drifting westward north of Franz Josef Land or Spitsbergen. The ship was caught in the ice in the Kara Sea in August, 1912, and drifted for a year and a half in a generally northerly direction. On April 23rd, 1914, when the vessel was at about 83 deg. N. and 60 deg. E., the mate and thirteen sailors left her, and two of them were found in Franz Josef Land by the Sedov expedition, with which they returned to Russia last autumn. Nothing further has been heard of Brussilov and the part of the expedition which remained on the ship, the "Saint Anna." Meanwhile, before news of the above events reached Europe a relief expedition under Capt. Sverdrup, on the "Eclipse," had been dispatched in search of the missing explorers, and followed their intended route to the eastward. At present this expedition is reported to be in winter quarters on the Taimyr Peninsula; i. e., in a region somewhat remote from the probable location of the Brussilov party if still alive.

## Portable Stump Boring Machine

IN the States of Michigan and Wisconsin, and also in several Southern States and on the Pacific Coast, there are large areas of undeveloped land, which at one time was covered by heavy forest growths, and which, after being "cut over" by the lumbermen, was abandoned as worthless, and eventually taken over by the State governments because of non-payment of taxes. Occasionally a small tract of such land is taken up by some energetic foreigner who, by extreme patience and much labor, manages to clear a small acreage. The land when once cleared is highly productive; in fact, some of the most fertile land in the United States is contained in the stump-ridden sections of the great lumber States.

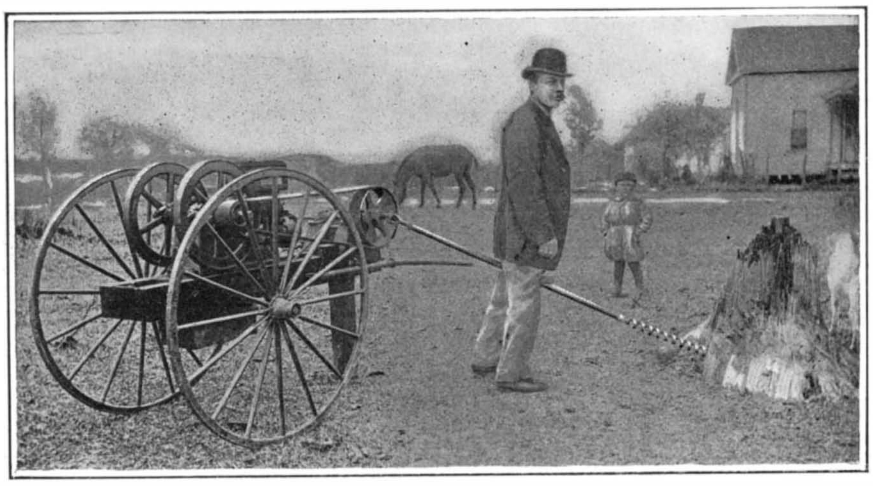
Recently a machine has been devised for removing the tree stumps. This machine consists of a 1½ horse-power gasoline engine mounted on two wheels fitted with a light frame. A countershaft is mounted on one end of this frame, and is operated by a belt from the engine. To the end of the countershaft is attached a universal joint, connected to a $\frac{13}{16}$-inch shaft, 4 feet long, and key-seated on two sides within 6 inches of the end. This shaft slides in a hollow tube, ⅞ inch inside diameter, and the tube and shaft are located by means of two keys which are fitted in the end of the hollow tube, and held in position by sleeves which screw to the tube.

An auger is fastened by a chuck to the hollow shaft, and is 2 inches in diameter, with a 3-inch shank, and 30-inch barrel. The shaft is fitted with a cross handle located about 18 inches from the auger, but which can be shifted to any desired position on the shaft. The purpose of this machine is to bore stumps, for burning, and the auger, when boring into sound wood, feeds itself, the operator having merely to steady it with the handles. After the hole is bored, the auger can easily be withdrawn while the engine is running. Under bad conditions, such as hollow and unsound stumps, the auger will sometimes need crowding by pressing the handles.

In order that the machine may be operated by one man, a hole is drilled in one end of the handle for a ⅝-inch sharpened pin to slip in and the bar is swung into position and the pin inserted in the ground to support the auger while the operator starts the engine. He then lifts the boring pin and applies it in any desired position to a 45-degree angle, and bores the hole.

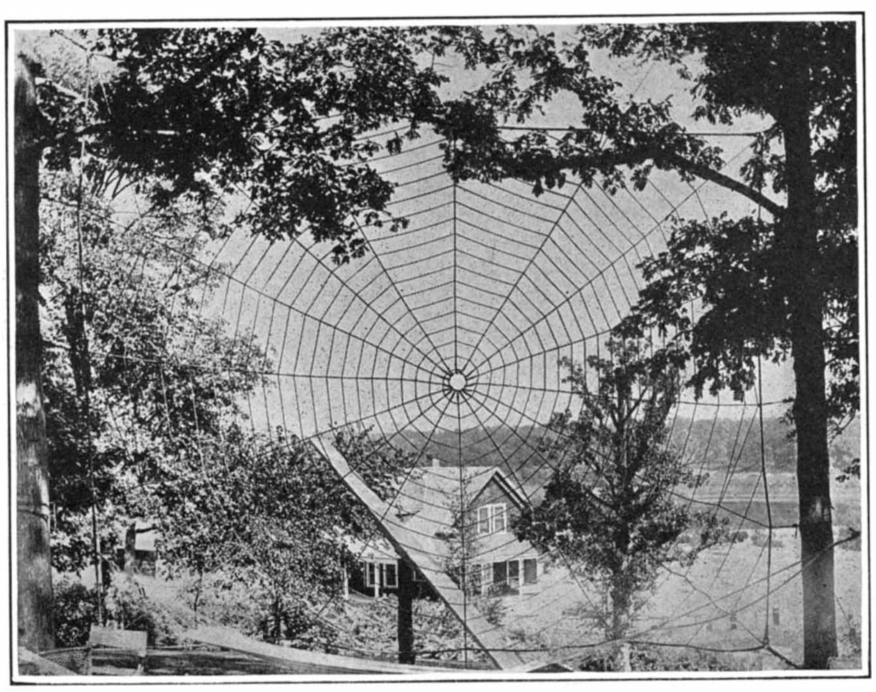
The method of procedure is to dig a hole approximately 14 inches deep along the top root of the stump with an ordinary spade. When the stump is pitted the machine is wheeled into position on the opposite side and the auger applied to the top root as close to the ground as possible. Its course through the stump is downward at an angle of 45 degrees, and it emerges at the bottom of the pit. It is then withdrawn and shavings are placed in the pit surrounding the auger hole and set on fire. The flue created by the auger hole ascending from the pit at an angle of 45 degrees, draws the flame through the hole and thus fired, it burns outward and downward until the stump is entirely consumed.

In a recent test two men operated the machine, and only one gallon of gasoline was required to bore one hundred stumps. The machine weighs 350 pounds, and can be transported on a one-horse wagon or wheeled by hand by the two operators from stump to stump on any desired area.

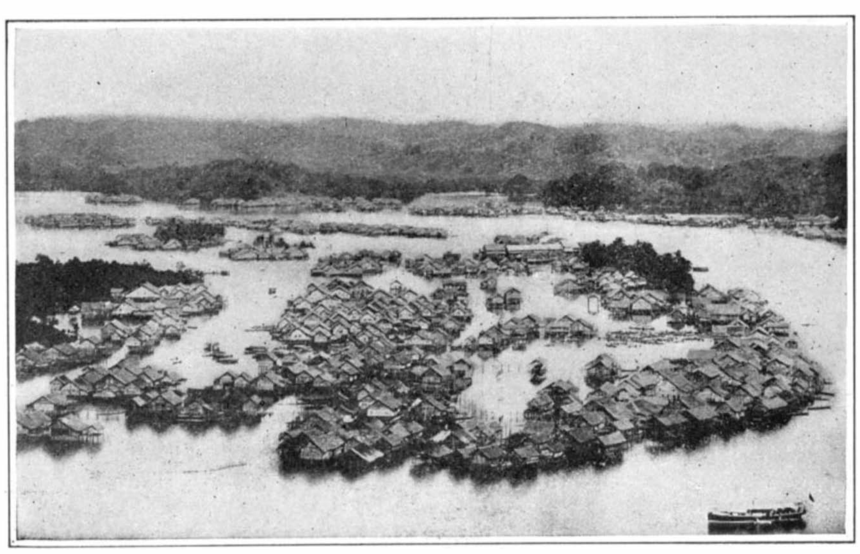


Boring a stump with a portable machine preparatory to burning it.


A giant that will type news bulletins at the Panama-Pacific Exposition.



Artificial spider web as a lawn decoration.



A Borneo city built on piles.

## A City on Piles

ONE of the strangest cities in the world is Brunei, capital of the State of the same name in Borneo. It has Venice completely outdone, for not only are its streets watercourses, but the entire city is built over the water. The city is located on the river Limbang, its houses being constructed on slender piles made from the Nibong palm, a wood that resists the action of water for many years.

The inhabitants of Brunei are Malays, Kadayans, Orang-Buskits, and a few Muruts. They earn their living mostly by trading with other tribes in the interior of Sarawak and British North Borneo. Some of them are very skillful brass workers, and Brunei women make very beautiful cloth, interwoven and embroidered with gold thread. Sago is grown in the valleys nearby, and a small quantity of rice is also raised there. In the early part of the nineteenth century Brunei was the headquarters of the famous Borneo pirates, and a market for the slave trade.

## The Largest Typewriter in the World

ONE of the exhibits at the Panama-Pacific Exposition which can hardly escape observation, is a typewriter of gigantic proportions. Lest their product be overlooked among the myriads of typewriters that are to be put on exhibition, an enterprising company has had a machine built 1,728 times larger than a standard typewriter. It is not merely a colossal image, but a working model that actually writes; and during the Exposition it will type news bulletins on a sheet of paper 9 feet wide, in letters 3 inches high and 2 inches apart. The monster machine will be operated by electrical connection with a typewriter of standard dimensions. For instance, on depressing a key of the small machine the corresponding key of the large machine will respond. A lever is used for the return of the carriage and for line spacing or rotating the cylinder. The big machine weighs 14 tons as against 30 pounds, which is the weight of a standard machine. It is 21 feet wide, in action, by 15 feet high, and requires for its operation a room measuring 25 by 30 by 25 feet. The platen, 9 feet 6 inches long by 21 inches in diameter, weighs 1,200 pounds, and the carriage 3,500 pounds. Each key cup, which is the part of a typewriter that is pressed by the fingers, is 7 inches in diameter, while each type bar is 52 inches long and weighs as much as a standard typewriter. This mammoth typewriter has been under construction for about two years and cost $100,000.

## The Largest Spider Web in the World

By Robert H. Moulton

THE largest spider web in the world was spun, not by a spider, but by human hands. It stands on the lawn of a Chicago man's country home, and is of such tremendous size as to startle the passerby when he first sees it.

The creator of this interesting oddity conceived the idea of attempting to see how closely an actual spider's web could be reproduced with rope. Selecting two immense trees on the lawn of his home, he spun between them this spider's web, forty by sixty feet, which is so strong that a boy or man may easily climb to the center or top of it.

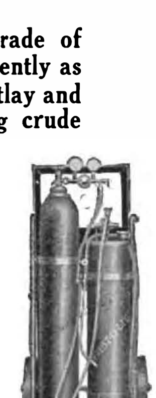
The web faces the main thoroughfare, which passes the house, and is one of the most fascinating country ground decorations ever seen. The spinner could not attain the minuteness of the actual spider's work, but came so near to it that the illusion is almost perfect. The uniqueness of the undertaking catches and fascinates every eye.

---

**Watch With One Hand.**—While watches without hands, or with but a single hand, are by no means new, an ingenious watch of the latter class, of French make, is interesting. On a semicircle at the top of the dial plate is a scale graduated to indicate minutes. The lower part of the watch face has a raised plate, and projecting from under it is a wide pointer which passes along the scale of minutes, so as to point to the minute figure. Near the end of the pointer is a large figure indicating the hour, 6 for instance. When the pointer reaches 60 on the minute scale it disappears under the plate and a new marker (7) appears at the zero side of the scale.





## The Government Ship Purchase Bill

(*Concluded from page 197.*)

and it is supremely binding upon us to maintain neutrality and equal friendship for all.

Finally I wish with all emphasis to make the statement that already during the discussion of this most unfortunate measure, the action of the Administration has done more harm to the very cause which it seeks to promote, namely, the establishment of a strong merchant marine, than any other influence that has brought it down to its present low level. I refer to the fact that the embarkation upon this scheme for Government ownership (for it is just that and nothing less) has had the effect of driving away private capital which otherwise would have been heavily and judiciously invested in new shipping. The proposal to expend $40,000,000 for a Government-owned fleet has probably prevented the investment of not less than $100,000,000 by private owners, who have been deterred from entering the market because of the uncertainty introduced into the situation by the proposed bill.

There are a certain number of ships in the world. The question is how to get them into operation. Will the Government, with its red tape and its bureaucracy, make these shipping units more effective than can the men who have made it a life work to manage them? The question suggests its answer.

Shipping is not like a business in which the Government has been engaged and which it has controlled for years, as it has the post office business. Here, in the winking of an eye, it is proposed to enter this field and place officials who have never been engaged in the shipping business in charge of a $40,000,000 corporation created to buy and operate ships. Whoever knew a great enterprise of that kind to succeed when placed in untried hands? When I say this I am not speaking disparagingly of the Secretary of the Treasury nor of any of the other cabinet officers. They simply would be called upon to assume a responsibility which they never ought to be asked to assume. They must enter, without either training or experience of any kind, upon the management of a business highly specialized, requiring particular skill and experience. And if they secure the ships, how are they going to operate them more efficiently than those who have made it a life work?

The American flag can no more be restored by this measure than by a subsidy, than which it is infinitely worse. Under a subsidy plan you at least know who your beneficiaries are. It is a plain, honest, straightforward method of attempting to do something, though I think in the wrong way. You know at least who will get the benefits of what your Government is doing. But under this plan of buying boats, fixing charters, sending them to this or that port of the country, and with this or that kind of a product, nobody knows who are the beneficiaries. It is all under the control, not of the general law but of a corporation, so called, and it is about the nearest to a fake corporation of any of which I have known for a long time.

## An Undefended Treasure Land

(*Concluded from page 199.*)

In all our wars we have been afflicted with its curse. Washington cried out against it. It was one of the great evils of the Civil War, and yet there are those who are so short-sighted and foolish as to advocate it at the present time. Its adoption means nothing but disaster and the looting of the public treasury, and indicates clearly on the part of all who propose it an entire ignorance or disregard of the teachings of history, so far as it relates to the workings of the bounty system in the armies of the Republic. Its result is merely the assemblage of a lot of men of unknown qualifications, who respond, not because of patriotism, but merely in order to secure the bounty offered. It is not only defective in that it secures a poor type of men, but it is vicious, in that it serves to place patriotism upon a straight money basis. The present reserve law is, in effect, a bounty system, which should be done away with

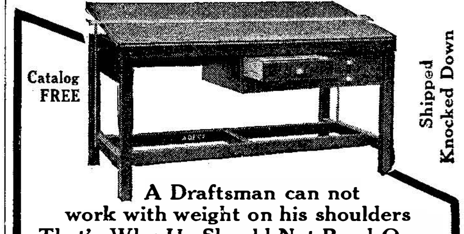


INQUIRIES

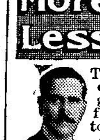
*Inquiry No. 9426.* Wanted the name and address of a manufacturer who can make 5/8" buoyant balls made into perfect spheres in large quantities. They are intended to take the place of cork. Possible wood pulp might be used.

*Inquiry No. 9427.* Wanted to secure patented device which is practical, not too expensive, and for which there is a real demand.

*Inquiry No. 9428.* Wanted to secure an interest in a manufacturing concern. Will buy part or entire interest. Must be a going concern.








and a straight monthly pay provided for the reservist. The enlistment contract for the regular army should be so drawn as to permit men to transfer to the reserve, which is equivalent to returning to civil life so far as freedom of occupation and movement is concerned as soon as they are qualified.

**Discharge from the Service by Purchase Should Be Abolished.**

Discharge by purchase should be abolished, and release from active service through transfer to the reserve should replace it and be dependent upon proficiency. In other words, a condition should be established under which men can be transferred to the reserve as soon as they are, in the opinion of the proper officers, well-trained soldiers. The men so transferred would continue in the reserve during the remaining period of their enlistment. In other words, if a man is enlisted for, say six years, three with the colors and three with the reserve, and qualifies for transfer at the end of a year, he would then serve five years in the reserve.

Such an enlistment contract will attract a much more intelligent class of men than at present. In other words, once this condition is established, men will come into the army who have no idea of making the military profession a life profession, but who do want to qualify to be efficient soldiers in time of war. Our general policy should be the instruction of the greatest possible number of men with the minimum of interference with their economic career.

**Every American Boy Has Military as Well as Civil Obligations.**

We should strive to impress upon every American boy the fact that he has an obligation to the State, from the military side, quite as binding upon him as his obligations from the civil side, and that obligation is that he should do everything possible to prepare himself to render efficient service as a soldier in time of war, and the State, on its side, should extend to him every opportunity to so prepare himself. The consciousness of this obligation will make our men more valuable as citizens, will give them a higher sense of responsibility toward the State, and will make them more conservative with reference to war, as they will appreciate fully that war will devolve upon them an obligation which they must fulfill.

## The Report of the Commissioner of Patents

THE annual report of the Commissioner of Patents shows that in 1914 there were received 67,774 applications for mechanical patents, 2,454 applications for design patents, 176 applications for reissues of patents, 8,851 applications for registration of trade-marks, 988 applications for registration of labels, and 434 applications for registration of prints. There were 41,660 patents issued, including designs; 190 patents reissued, and 6,817 trade-marks, 719 labels, and 338 prints registered. The number of patents that expired was 22,098.

The total receipts were $2,251,892.82. The expenditures were $2,000,770.12. The excess of receipts over expenditures during the calendar year ending December 31st, 1914, amounts to $251,122.70. The surplus will probably be still larger during the coming year.

There is also an accumulated surplus of $7,548,175.16, as shown by the receipts and expenditures of the office since it was organized.

Notwithstanding this large sum that has been fairly earned and justly belongs to this particular department, and the repeated representations showing that the office is overcrowded to an extent that seriously interferes with and delays the business of the office Congress steadily ignores the situation, and the only apparent hope of betterment is the possibility that, within the next two or three years the interior department may get a new building, and that when this occurs, the Patent Office may be given a portion of the old quarters vacated in the Land Office Building.

In the meantime conditions are constantly and rapidly getting worse. And

moreover, the records, which it would be impossible to replace, are in great danger of destruction by fire. Another place where this lack of room and facilities is badly felt is in the library, which consists of an invaluable collection of 75,000 scientific books and 2,000,000 foreign patents, and which is indispensable not only to those connected with the department, but is also used extensively by many others. Here conditions are such that much of the valuable material is not available for use, and the entire collection, like the records, is constantly menaced by fire. To say the least, conditions in the Patent Office are by no means creditable to Congress.

A summing up of the work in the office shows that there was a considerably smaller number of applications awaiting official action on January 1st, 1915, than at the same date of the preceding year, and although the decrease was almost entirely in applications that had been acted on once, still this indicates an improvement.

A change in office practice that has been made is in handling interferences. Hitherto each of the forty-three examiners has declared interferences, each according to his own judgment, and this has led to great discrepancies. Since December, 1913, one of the two law examiners has consulted with the primary examiner whether an interference should be declared, and far greater uniformity in practice has been secured. One result of this system is that since it was established, of the total number of proposed interferences reported to the law examiner 26 per cent have been rejected, and in 10 per cent of the cases the issues were modified, and this in spite of the fact that 33 per cent more applications were passed in 1914 than during the previous year. Another commendable feature of the new practice is that in case of a motion for dissolution the law examiner who instituted the interference does not hear the motion, which was contrary to the previous methods, where the same examiner who declared the interference heard all motions in relation to the dissolution of his action. There are other directions where the knowledge of the law examiners would prove of decided advantage, both to the department and to applicants, and it is recommended that at least three additional law examiners be appointed—a recommendation that Congress will probably ignore.

An increase in the Board of Examiners in chief is also desirable, as not only is the present business greater than they can properly attend to, but in cases of appeals the absence of one member frequently leaves a divided board, and the absence of two suspends the work of the board.

The number of trade-marks and patents for designs is steadily increasing, and here, as in other divisions, assistance is needed.

Among a number of suggestions for changes in the law is one to require the clerks of the Federal courts to file a copy of every decree granting or refusing an injunction in a suit for infringement of a patent and every final decree affecting the validity of a patent.

If such copies were filed it would enable any one to determine the litigation in which this patent had been involved—a thing which is now practically impossible, since many of the decisions of the lower courts are not published.

Another suggestion is in regard to protecting designs. The problems of a court in passing upon the validity and infringement of design patents are so simple, generally speaking, as not to require the assistance of expert opinion. Little or nothing, therefore, is gained by examination prior to the granting of a patent. It is recommended that protection of designs be put upon a registration basis and the fees be greatly reduced.

Great delay often occurs from the omission of the signature of a witness to a drawing, frequently necessitating the filing of substitute papers, and involving the office and the applicant in much additional work; and as such witnesses are of no practical value or importance it is recommended to change the law to omit the requirement of witnesses to signatures; and to include an acknowledgment of the signature of the specification in the oath.

# DODGE BROTHERS MOTOR CAR

You can feel sure that the car is exactly as good as it looks if you will remember the wide experience which Dodge Brothers have had in motor car construction

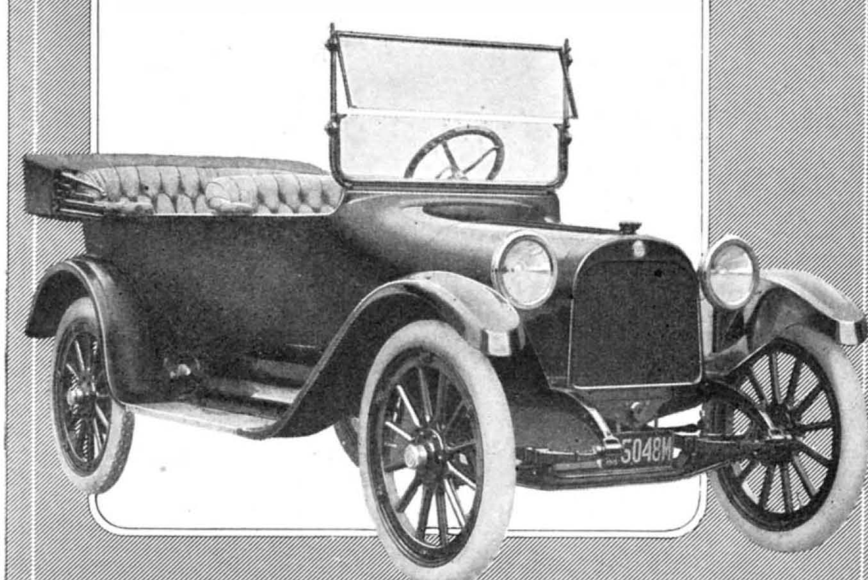
Surely it is not assuming too much, for example, to say that Dodge Brothers should be skilled in axle construction, as they have manufactured as many as 225,000 rear axles per year.

The wheelbase is 110 inches

The price of the car complete is $785 f. o. b. Detroit

Canadian price, $1100 (add freight from Detroit)

DODGE BROTHERS, DETROIT




# The Gyroscope

The mysterious behavior of the gyroscope is a source of wonder to everyone. From a curious toy, the gyroscope is being developed into a device of great practical value. Its theory and its method of action are set forth up to the latest moment in the Scientific American Supplement. The following numbers are of great interest and usefulness:

**Scientific American Supplement No. 1501**—Treats of the Mechanics of the Gyroscope. A clear explanation without mathematics.

**Scientific American Supplement No. 1534**—"Little-known Properties of the Gyroscope" describes a peculiar action not generally observed, and discusses the effect of this property upon the motions of the planets.

**Scientific American Supplement No. 1864**—The Gyro Compass, its principle and construction.

**Scientific American Supplement No. 1621**—The Gyrostat for Ships describes the construction and application of the principle to prevent rolling of vessels.

**Scientific American Supplement No. 1943**—Gyroscopic Stabilizer for Ships, by Elmer A. Sperry.

**Scientific American Supplement No. 1694**—Gyroscopic Apparatus for Preventing Ships from Rolling, takes up the Schlick invention described first in No. 1621, and discusses its action and results fully.

**Scientific American Supplement No. 1645**—The Theory of the Gyroscope is an excellent article, treating the subject mathematically, rather than popularly.

**Scientific American Supplement No. 1649**—The Gyroscope, is an article giving a full discussion of the instrument without mathematics, and in language within the comprehension of all interested.

**Scientific American Supplement No. 1716**—A Recent Development in Gyroscopic Design, illustrates a new form of gyroscope and mounting adapted to engineering uses.

**Scientific American Supplement No. 1643**—The Gyroscope for Balancing Aeroplanes, takes up this interesting field, which the gyroscope alone seems capable of occupying.

**Scientific American Supplement No. 1741**—Gyroscopic Balancing of Aeroplanes, tells of various suggested methods of maintaining equilibrium.

**Scientific American Supplement No. 1773**—The Wonderful Gyroscope, gives diagrams of the Gyroscope and its action, and applications to maintaining stability of ships and monorail trains.

**Scientific American Supplement No. 1872**—The Mechanical Principles of Brennan's Monorail Car. A lucid exposition.

**Scientific American Supplement No. 1814**—The Regnard Aeroplane, describes the latest design of aeroplane stabilizer, from which great things are expected.

**Scientific American Supplement No. 1861**—The gyrostatic force of rotary engines, its nature and significance for aviation.

EACH number of the Supplement costs 10 cents. A set of papers containing all the articles here mentioned will be mailed for $1.50.

SEND for a copy of the 1910 Supplement Catalogue, free to any address. Order from your newsdealer, or the publishers.

MUNN & CO. INC.
*Publishers*
361 Broadway
New York City

## *When All Other Encyclopaedias Fail*

# Look It Up in NELSON'S

Nelson's is the recognized standard reference work wherever English is spoken maintaining three great Editorial Staffs, employing over 1,200 of the greatest scientists, experts and writers in all parts of the globe, who are authorities or actual eye-witnesses of the subjects upon which they write. The fact that over 500,000 people in every quarter of the globe are using NELSON'S ENCYCLOPÆDIA is in itself the highest recommendation; for no book which is not thoroughly reliable could stand the inquisition of these hundreds of thousands of readers.

# NELSON'S *Perpetual Loose-Leaf* ENCYCLOPÆDIA & Research Bureau for Special Information


Reg. U.S. Pat. Office **That little Bar and Nut has solved the problem**

**BOUND IN 12 HANDSOME VOLUMES**

## Besides This Great Encyclopaedia

Every purchaser of Nelson's is entitled to membership in Nelson's Information Bureau absolutely without cost. This means that if at any time you wish a special report on any subject, large or small, old or new, you simply write to Nelson's Research Bureau with the positive assurance that you will promptly receive the latest obtainable and most dependable information on that subject. Thousands of satisfied patrons have endorsed Nelson's Research Bureau.

**Revision Pages**—Nelson's perfected Patented Binding Device has demonstrated to Colleges, Libraries, School Boards and leading men in all walks of life that Nelson's Loose-Leaf Encyclopaedia is the only perfect Reference Work for to-day, to-morrow and all time. To keep subscribers up-to-date we furnish 250 or more revised pages every six months. By simply turning that small nut at the top and bottom of each volume you loosen the binder—take out the obsolete pages and replace them with the new pages which contain the world's happenings and activities of the past six months—and your Encyclopaedia is fresh and new again.

## *IT IS A COMPLETE LIBRARY IN ITSELF*

It provides you with the knowledge of centuries. It gives you the essence of all books. It furnishes precisely the information wanted on every possible subject. It contains over 70,000 subjects, featuring upward of one million topics, seven thousand illustrations, 500 maps and plans, among them being Aeronautics (including all kinds of flying machines), Agriculture, Anthropology (the science of mankind), Ethnology (the science which accounts for racial diversities). Biology (the science of life) Astronomy, Biography, Botany, Chemistry, Education, Electricity, Engineering, Mechanics, and Machinery, Gazetteer, Geology and Geography, History, Law, Mathematics, Medicine and Surgery, Music and Fine Arts, Political Science, Sociology and Economics, Religion, Sports, Technology and Manufacture, Military and Naval Science and thousands of others.

## *The Present War in Europe Will Change*

**the map and history of the world. When the war is over all other works of reference will be out of date. Only Nelson's Loose-leaf system can keep step with the progress of the world. Nelson's now contains a complete record of the present war, its causes and consequences, down to February 15, 1915. NELSON'S NEVER GROWS OLD.**

***NELSON'S IS THE ONLY ENCYCLOPAEDIA ALWAYS UP-TO-DATE***

*Mail the Coupon To-day for Handsome Sample Pages and Full Particulars.*

***EXCHANGE*** **We are constantly receiving inquiries asking us to make an allowance for old encyclopaedias to apply as part payment on NELSON'S. We have therefore prepared a price list, stating the amount allowed, which will be mailed upon request.**

## *THOMAS NELSON & SONS*

*Dept. 21-C, 381-385 Fourth Avenue, New York City*
*Publishers Since 1798—Bibles, Hymnals, Prayer Books*

**Dept. 21-C**

**Thomas Nelson & Sons**
**381-385 Fourth Ave.**
**New York City**

Please send me portfolio of sample pages; also full information how, by easy monthly payments, I can own NELSON'S PERPETUAL LOOSE-LEAF ENCYCLOPÆDIA. This incurs no obligation on my part.

*Name*..............................

*Address*..............................

*City*..............................

*State*..............................

*A Selected List of Practical Books dealing with*

# Automobiles, Tractors, Motorcycles and Gas Engines

### *Modern Gasoline Automobile*

Its Design, Construction and Repair.
By VICTOR W. PAGÉ. 5½ x 7¾. Cloth. 816 pages, 500 illustrations, 11 folding plates. Price, $2.50.

¶ The most complete, practical and up-to-date treatise on gasoline automobiles, explaining fully all principles pertaining to gasoline automobiles and their component parts. It contains the latest and most reliable information on all phases of automobile construction, operation, maintenance and repair. Every part of the automobile, its equipment, accessories, tools, supplies, spare parts necessary, etc. are fully discussed. It is clearly and concisely written by an expert familiar with every branch of the automobile industry. It is not too technical for the layman nor too elementary for the more expert, and is right up-to-date and complete in every detail.

### *Motorcycles, Side Cars and Cyclecars*

Construction, Management, Repair.
By VICTOR W. PAGÉ. 5¼ x 7½. Cloth. 550 pages, 339 illustrations, 5 folding plates. Price, $1.50.

¶ A new, complete, non-technical work, describing fully all leading types of machines, their design, construction, operation, maintenance and repair. It explains in detail the operation of two and four cycle power plants and all ignition, carburetion and lubricating systems. The representative types of free engine clutches, variable speed gears and power transmission systems are fully discussed. Electric self-starting and lighting systems, all types of spring frames and spring forks and leading control methods are considered. It also gives complete instructions for operating and repairing all types, and suggestions for locating troubles.

### *Questions and Answers Relating to Modern Automobile Construction, Driving and Repair*

By VICTOR W. PAGÉ. 5¼ x 7½. Cloth. 622 pages, 392 illustrations, 3 folding plates. Price, $1.50.

¶ A practical self-instructor for students, mechanics and motorists, consisting of thirty-six lessons in the form of questions and answers, written with special reference to the requirements of the non-technical reader desiring easily understood explanatory matter relating to all branches of automobiling. A popular work at a popular price.

### *Gasoline Engine on the Farm*

By XENO W. PUTNAM. 5¼ x 7½. Cloth. 527 pages, 179 illustrations. Price, $2.00.

¶ A useful and practical treatise on the modern gasoline and kerosene engine, its construction, management, repair, and the many uses to which it can be applied in present-day farm life. It considers all the various household, shop and field uses of this up-to-date motor and includes chapters on engine installation, power transmission and the best arrangement of the power plant in reference to the work.

### *Gasoline Engine Troubles Made Easy*

Arranged by VICTOR W. PAGÉ. Size, 24 x 38 inches. Price, 25 cents.

¶ A chart showing clearly all parts of a typical four-cylinder gasoline engine of the four-cycle type. It outlines distinctly all parts liable to give trouble, and also details the derangements apt to interfere with smooth engine operation. It simplifies the location of all engine troubles.

*Upon receipt of the prices quoted above we forward these books by mail or express prepaid to any address. Our catalogue of scientific and technical books sent free on request.*

*SEND US YOUR ORDER OR REQUEST TODAY*

**MUNN & CO., Inc., *Publishers*** **361 Broadway, New York, N. Y.**

Cadillac
Standard of the World

# More than 4500 owners will now tell you of the wonders of

# The Eight-Cylinder Cadillac

At long intervals there appears a product, about which the whole truth cannot at once be told.

If *all* of its new and wonderful qualities were set forth, before the public had actually experienced them, the description might not be credited.

When we issued our initial announcement of the Cadillac with its Eight Cylinder V-type Engine, we found ourselves in precisely this position.

The most ordinary statement of its advantages appeared overdrawn.

Our certainty that it would revolutionize motoring amounted to a conviction.

But we dared not tax the credulity of the public, by telling the entire story, even though the public has always reposed implicit confidence in Cadillac announcements.

Our one thought was to hold ourselves within bounds—to be temperate—to place a check upon our own enthusiasm.

We told only a part of the truth—and yet we are conscious, now, that some of our statements must have sounded at least a trifle fervid, coming from a company committed to conservatism.

But there is no need now to understate the case, ***because the public knows.***

The strongest statements which we made are mild by comparison with those which are echoing from one end of the country to the other.

Thus we said, in an early announcement, that in the new Cadillac "good roads yield up a velvet quality of travel undreamed of."

We said that "bad roads lose much of their terror, and hills seem almost to flatten out before you."

Many a man no doubt made the mental comment that these were strong claims.

But they are as nothing to the assertions which you can and will hear in every city in which the new Cadillac is being driven today.

Again, we said, that the Cadillac Eight Cylinder V-type engine "produced eight impulses in every cycle—overlapping so completely that they melt and merge, one into another."

And, we added, that this power, "ebbs and flows so flexibly that the car can be operated almost continuously under throttle control, without change of gears."

Consult your own Cadillac acquaintances, and you will find that this condition of almost continuous throttle control is a commonplace of the Cadillac owner's every-day experience.

We said that "the motor did not seem to be driving the car, but rather to have given it wings"—and the Cadillac owner will express his riding sensations, today, in even stronger terms than these.

The burden of testimony has passed from us to the finest citizenship of the land.

The uttermost that we might say is being outdone by our friends. The Cadillac car itself, and the owners of the Cadillac have relieved us of the necessity of praising our own product.

We do not believe that anyone, after riding in this car, can resist the charm of such surpassing ease, smoothness, steadiness and flexibility of power.

Our conviction is that the enthusiasm over the Eight Cylinder Cadillac means nothing short of a national conversion.

## Styles and Prices

Standard Seven passenger car, Five passenger Salon and Roadster, $1975. Landaulet Coupe, $2500. Five passenger Sedan, $2800. Seven passenger Limousine, $3450. Prices F. O. B. Detroit.

Cadillac Motor Car Co. Detroit, Mich.

SCIENTIFIC AMERICAN


Vol. CXII. No. 10
March 6, 1915

Munn & Co., Inc., Publishers
New York, N. Y.

Price 15 Cents
$3.00 A Year

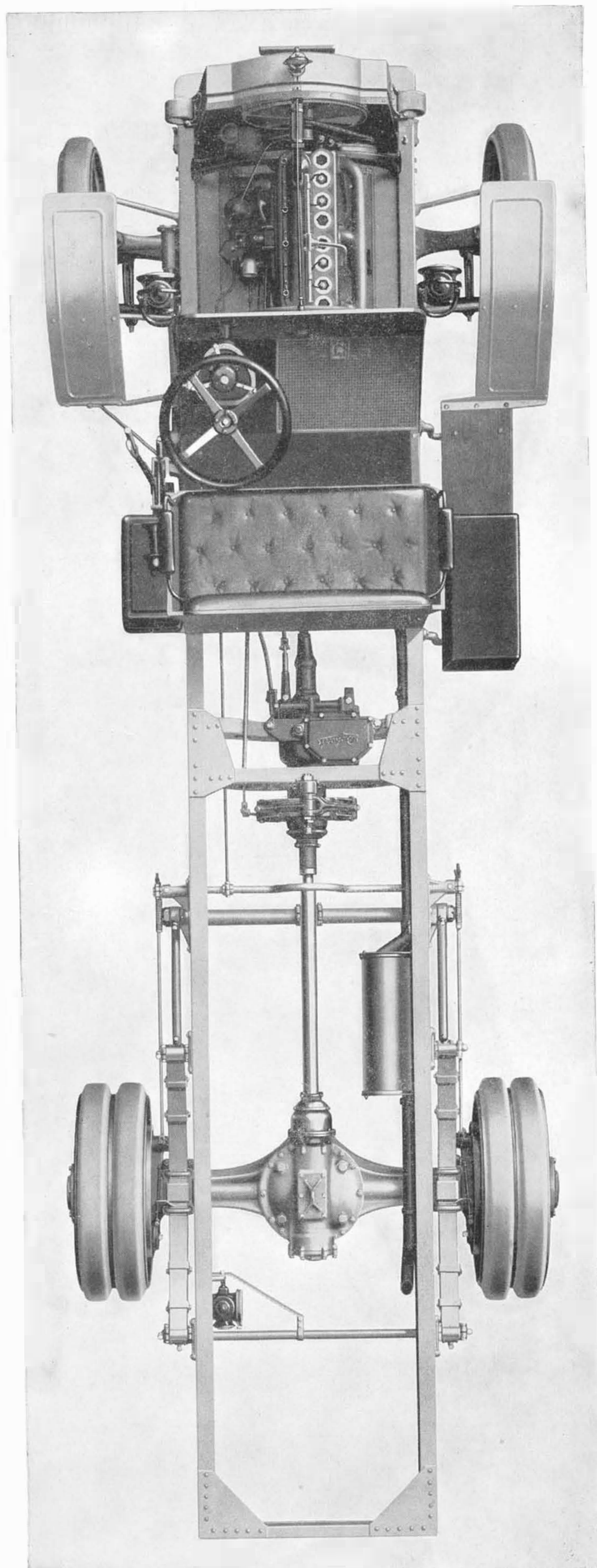
# YOU CAN PUT YOUR FINGERS ON THE SAVING IN THE NEW PACKARD TRUCKS

*The improved Packard Models furnish the surest, quickest and most economical means of transportation.*

*They put an end to the rule-of-thumb extravagance of horse hauling.*

*There is nothing obscure or hidden about their wide range of usefulness and their low cost of upkeep.*

*You can put your fingers squarely on the reasons why Packard trucks may be operated with the least expense and the least manual work.*



(Plan View of Chassis—3-Ton Unit)

You can see for yourself that the compact, clean-cut chassis has no unnecessary parts—that all the working units are enclosed from mud and water—that wear is taken by small inexpensive parts and not by large parts more difficult and costly to replace—that a minimum need of adjustments saves the driver's time and the owner's money.

Centralized control within easy reach of the driver, special electric cranking and lighting system, left side steering and improved worm drive, are additional proofs that the new type Packard is the nearest approach to the ultimate truck.

The design is founded on the experience of thousands of Packard truck users and the evidence gathered under every possible hauling condition.

**Capacities from one to six tons inclusive.**

**Why not have a talk with a Packard dealer or write us for catalogs and further details.**

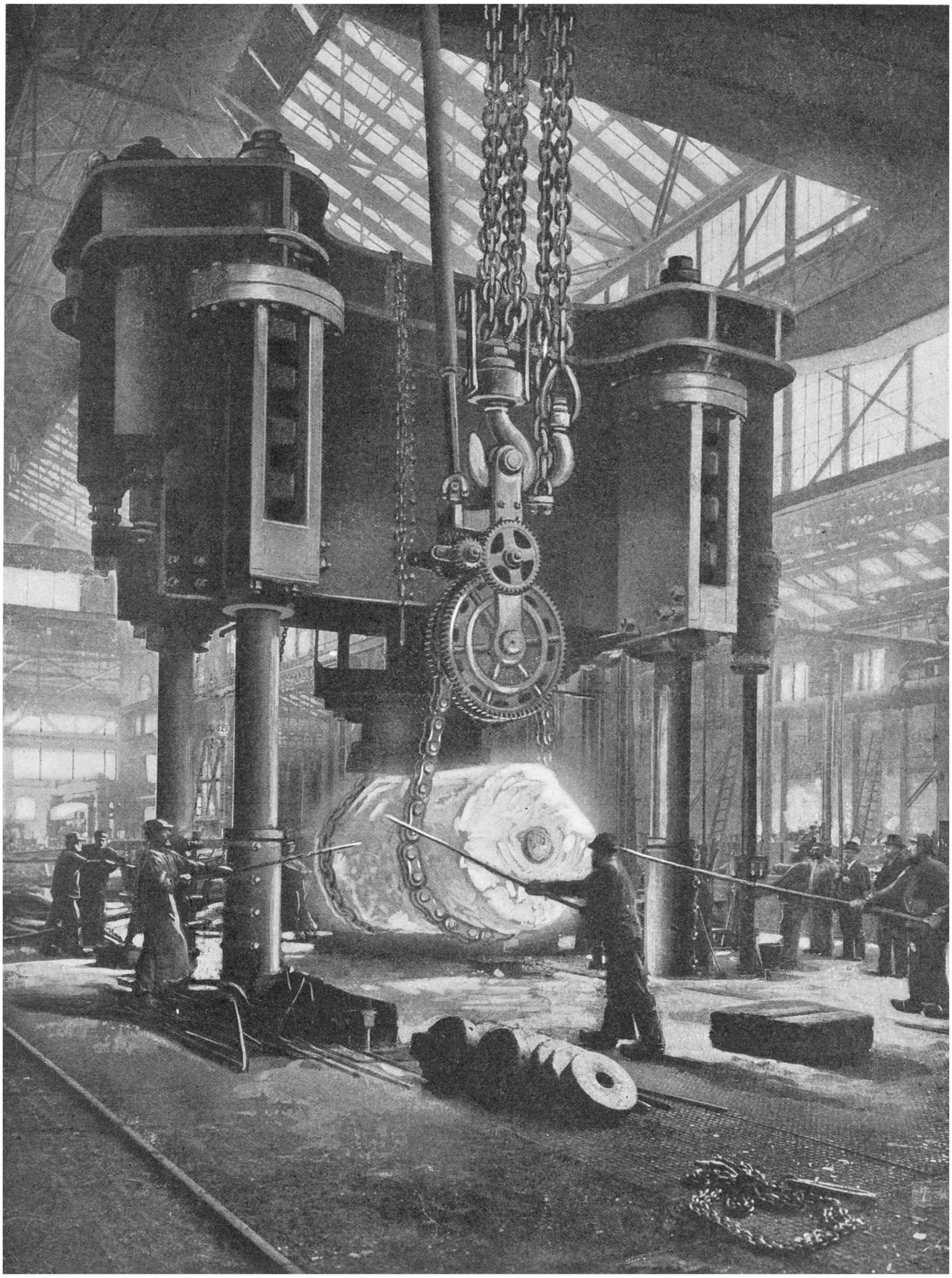
## PACKARD MOTOR CAR CO., DETROIT

SEVENTY-FIRST YEAR

# SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

VOLUME CXII. NUMBER 10. | NEW YORK, MARCH 6, 1915 | 15 CENTS A COPY $3.00 A YEAR



FORGING INNER TUBE FOR A GERMAN 16.8-INCH SIEGE GUN IN THE FAMOUS KRUPP WORKS AT ESSEN.—[See page 216.]

# SCIENTIFIC AMERICAN

**Founded 1845**

**NEW YORK, SATURDAY, MARCH 6, 1915**

Published by Munn & Co., Incorporated. Charles Allen Munn. President; Frederick Converse Beach, Secretary
Orson D. Munn. Treasurer
all at 361 Broadway, New York

Entered at the Post Office of New York. N. Y., as Second Class Matter
Entered as Second Class Matter at the Post Office Department, Canada.

Trade Mark Registered in the United States Patent Office



**Subscription Rates**

| | |
|---|---|
| Subscription one year ................................ | $3.00 |
| Postage prepaid in United States and possessions. Mexico, Cuba, and Panama | |
| Subscriptions for Foreign Countries, one year, postage prepaid, | 4.50 |
| Subscriptions for Canada, one year, postage prepaid......... | 3.75 |

**The Scientific American Publications**

| | | |
|---|---|---|
| Scientific American (established 1845).......... | per year. | $3.00 |
| Scientific American Supplement established 1876. | " " | 5.00 |
| American Homes and Gardens................ | " " | 3.00 |

The combined subscription rates and rates to foreign countries including Canada, will be furnished upon application.
Remit by postal or express money order, bank draft or check

**Munn & Co., Inc., 361 Broadway, New York**

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp* the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.


*The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.*

## General Locomotive

THE decisive factor in the titanic struggle which is sweeping to and fro over the plains of Poland and East Prussia is not Gen. von Hindenburg nor Grand Duke Nicholas, but Gen. Locomotive.

After giving due credit to the strategical skill of the German and Russian generals, to the wonderful military efficiency of the German army, and to the traditional stubbornness and bravery of the Russian infantry, it has become evident during the first six months of the great war that the fundamental determining condition of success, for one side or the other, is the propinquity of the contending armies to the network of military railroads which approaches and everywhere covers the German frontiers.

One of the most illuminating bits of literature which anyone can read at the present time is the second chapter of Gen. Kouropatkin's great work entitled "The Russian Army and the Japanese War." Gen. Kouropatkin, as we all know, was the commander-in-chief of the Russian armies during the greater part of that memorable conflict. At the conclusion of the war he retired to his estates in Russia and devoted his time to writing this voluminous work, the second chapter of the first volume of which is devoted to a discussion of Russia's eleven thousand miles of frontiers in Europe and Asia. At the close of the chapter he says: "An analysis of the strength and resources of our nearest neighbors forced me to the conclusion that our western frontier has never in the whole history of Russia been exposed to such danger in the event of a European war as it is now, and that accordingly the attention of the War Department in the first years of the present century should be confined to strengthening our position on that side and not diverted to aggressive enterprises elsewhere."

Earlier in the chapter, and in explanation of the disadvantageous position of Russia with regard to Germany and Austria, he says: "The German frontier, 738 miles in length, follows no natural feature. Beyond it lies our nearest neighbor—a nation with whom we have been in close social and economic relationship ever since we got into touch with European life." He points out that the principal, and practically decisive, superiority of Germany lies in her railways. "To her seventeen lines," he says, "running to our frontiers, we can oppose only five. This advantage is overwhelming and gives to her and Austria a superiority which can be counterbalanced neither by large numbers nor by bravery."

As regards Austria, he points out that in the matter of railway development, the Austrians have also an enormous advantage. "While they, by means of eight lines of rail containing ten tracks, can run two hundred and sixty trains up to the frontier every twenty-four hours, we can convey troops up to the same point only on four lines." And he gives it as his opinion that Austria can concentrate 1,000,000 men within the area between the Carpathians and the Russian frontier within a very short space of time.

These words were written in 1909; and at the outbreak of the present war Russia was proceeding to put into operation a scheme for giving her army a mobility equal to that of Austria and Germany, by constructing a system of military railroads, leading up to and paralleling her 1,500 miles of frontier which are conterminous with those two countries. The war, however, found Russia in about the same condition of immobility that existed at the time Kouropatkin's book was written; and although the manifest superiority of the Russian troops to those of Austria has enabled Russia to carry the war to the line of the Carpathians, she has never been able to make any advance in force beyond the German frontier except in East Prussia. Here, already, she has suffered the two greatest defeats in her history, and in each case the defeat has been mainly due to the ability of Von Hindenburg to concentrate rapidly against the enemy an overwhelming force which was rushed there over the admirable German system of railroads.

We cannot forbear drawing attention to the fact that, both in the victory at Tannenberg and, apparently, in the recent defeat in East Prussia, the Germans captured, if the reports they have given us are correct, over 90,000 men. That is to say, within a period of six months they have twice captured a military force equal to the whole of the effective regular and militia army at present avilable in the United States.

## Peace Insurance

THAT the cost of providing naval and military forces sufficient to protect this country from invasion may very properly be regarded as money appropriated for the maintenance of peace, is fully borne out by a review of our past military history. That a condition of military preparedness can be obtained at a very small cost compared with the expenditures made by the nation for personal comfort and the luxuries of life, is proved by Governmental statistics. By similar indisputable authority, it can be shown that the loss of life, when war has to be undergone, is amazingly small in comparison to the loss of life which is daily occurring through accidents, the greater part of which are preventable.

The most telling statement of the case which we have seen for a long time is presented by Richard Stockton, Jr., in his work entitled "Peace Insurance"—a book which we commend to the careful perusal of those extreme pacificists who have so far lost their heads, or at least their sense of proportion, as not only to oppose the greatly needed increase in our naval and military forces, but even to advocate the abolition of these altogether.

The most telling portion of the book is a series of diagrams, presenting the whole gist of the argument in a graphic form, the immediate appeal of which is so strong that it must force conviction on any mind that is not absolutely beclouded by prejudice. The diagrams are merely graphic representations of facts which have been taken from carefully-compiled Government statistics, and which, therefore, may be taken as reliable. Thus, we find that the cost of peace insurance amounts annually to $245,000,000, that being the annual appropriation for the maintenance of our Army and Navy. With this may be compared the annual cost of insurance against fire and crime of $594,186,104.

To those people who complain of the shameful waste of the nation's money, entailed in the building of battleships and the manufacture of artillery, we direct attention to the diagram comparing the money spent on the Army and Navy with that expended by the people of this country for the luxuries and indulgences of life. For soft drinks, candy, etc., we spend in the United States, $452,000,000; on automobiles, $500,000,000; on jewelry, $800,000,000; on immorality, $3,000,000,000, and on liquor and tobacco, $3,200,000,000; that is to say, the country spends twenty-five times as much on liquor, tobacco, and vice as it does on its naval and military defenses.

It is a great thing to keep a level head and preserve one's sense of proportion; and if we do this, and look at things as they are, we find that not only is the expense for peace insurance a mere bagatelle compared with what the nation is willing to spend for self-indulgence, but also the surprising discovery is made that the deaths through war do not begin to be comparable to the deaths from accidents due to following the pursuits of peace. In a remarkable diagram Richard Stockton shows that the peace accidents in a single year in this country reach a total of 79,000; whereas the average annual Japanese loss during the Russian war was 33,340; the average annual loss during the civil war was 27,518; the English loss for one year during the Boer war was only 2,990; the French loss in the Crimean war during one year was 8,160, and the English loss in the same year was 2,387; the United States loss in the Mexican war was only 725, and our loss in the Spanish war was only 862. If the totals for all these wars are added together, we find that the total annual loss was 75,982, or 3,000 less than the annual loss in this country from accidents.

Again, we direct attention to a diagram showing what is recommended by way of peace insurance by the General Staff of the United States Army. As matters now stand, we find that for an annual expenditure of $110,000,000 we have an effective strength of the Army and National Guard of 150,000 men. As against that, if the recommendations of the General Staff be followed, for a proposed expenditure of $157,000,000, we shall have an effective army of 550,000 men; that is to say, an increase of $47,000,000 to secure 400,000 additional troops.

As matters now stand, the United States is helpless against invasion; if the General Staff recommendations are followed, we shall be able, by the expenditure of $47,000,000, to insure the peace of the country by discouraging any naval and military attack by a foreign power.

## Perfumery Farming in the United States

THE interruption, due to the war, in the supply of many articles of commerce that we have been in the habit of receiving from the Old World has given special point to the perennial question, Can we not produce these things in America? The indications are that the war, especially if it is long protracted, will lead to an economic declaration of independence on the part of this country in many lines of industry.

While the manufacture of perfumery has become an important industry in the United States, the cultivation of perfume-yielding plants in this connection, except a half dozen species which will be mentioned later, is still almost entirely neglected on this side of the Atlantic.

Though a few well-known scents, such as musk and civet, are obtained from animal sources, and certain others can be produced "synthetically" from their chemical elements, the great majority of perfumes are derived from plant products of the class known as volatile or essential oils. These oils are obtained from various parts of the plants in question. They are yielded by the leaves of bay, wintergreen, pine, lemon grass, citronella, patchouli, and rose geranium; by the blossoms of the rose, violet, heliotrope, orange, acacia, jasmine, tuberose, and mignonette; by the flowering heads, including the green parts, of lavender; by the rinds of citrus fruits, including orange, lemon, and bergamot; by the kernels of bitter almonds; by the wood of sandalwood, red cedar, and rhodium; by the inner bark of sweet birch and sassafras; and by the roots of certain species of Iris (orris-root). This list might be extended almost indefinitely.

A few essential oils, including those of peppermint, spearmint, sweet birch, sassafras, eucalyptus, wormwood, and tansy, have been produced more or less extensively in the United States. This fact ought to encourage an investigation of other possibilities in the line of perfume production in this country. Of course, a great many plants from which perfumes are obtained abroad are already in common cultivation for other purposes in the United States. On the other hand, it is probable that our native flora includes a number of species capable of yielding attractive and hitherto unknown perfumes. Desultory experiments have already been made in extracting scents of the yellow jessamine, sweet goldenrod, spice bush, etc., while the swamp magnolia, wild azalea, and wild grape have been suggested as promising sources of perfumery having a market value.

The production of perfume oils abroad has always been markedly localized, from which fact it might be inferred that peculiar conditions of soil or climate are necessary to success in this field. To a certain extent this assumption is correct, for the quality and quantity of the scents produced by certain plants do vary greatly with the conditions under which they are grown. Thus a better grade of lavender is produced in England than in continental Europe, though the species of the plant is the same. The fragrance of roses appears to depend upon abundant sunshine and a moderately rich, but not over-rich, soil. Ample moisture is beneficial for certain scents, but harmful for others. Even so, in the vast area of the United States it seems likely that the physical conditions of each of the most favored perfume-growing regions of Europe might be duplicated. For instance, the climatologist could probably point out regions in this country reproducing very closely the meteorological characteristics of the world-renowned perfume-growing district of Provence, or, again, the sunny slopes of the Balkans, from which comes the best attar of roses. Moreover, it is not impossible that we actually have *more* promising regions for this industry than any of those in which it is now established abroad.

Undoubtedly the amount of hand labor required in perfume farming is the main reason why it has hitherto thriven more in Europe than America. However, in our Southern States, where the climate is, on the whole, most favorable for this branch of agriculture, labor is also comparatively cheap. After the crop is gathered, the various processes employed to obtain the oils—expression, distillation, *enfleurage*, and maceration—do not present great difficulties, and might, indeed, be much improved if Yankee ingenuity were brought to bear upon them.

## Notes on the War

**Is the "Audacious" Still Afloat?**—We note that the leading papers of this city have given publicity to a detailed story to the effect that the "Audacious," which was reported to have been sunk off Lough Swilly, did not actually founder but was towed into port, has been repaired, and has again taken her place in the Grand Fleet. According to this story, immediately after the explosion, collision mats were thrown overboard, and, by means of sandbags and extemporized bulkheads and cofferdams, the inflow of water was so far cut off that the pumps were able to master the situation. The vessel, if we are to credit the report, was towed into Belfast, and repairs were executed with such dispatch that the ship is now in first-class condition.

**The Fate of the "Koenigsberg."**—But little has been reported of the fate of the German cruiser "Koenigsberg," which was forced to take refuge in the Rufigi River last October by the British cruiser "Chatham." Owing to her greater draught the "Chatham" could not enter the river, and the German vessel was so thoroughly concealed by the surrounding trees and by being covered with foliage that her range could not at first be obtained. To meet these conditions a small crew from the "Chatham" took an English commercial steamer up the channel and sunk her where the hulk would effectually block the escape of the "Koenigsberg." A damaged cable ship was also sunk in the channel. Shortly afterward an aeroplane was shipped to the scene of operations, and the location of the "Koenigsberg" was soon ascertained and the vessel entirely destroyed by the gun-fire of the "Chatham." The German liner "Somali," which acted as a supply ship, was also destroyed.

**Science in Warfare.**—As soon as the Germans had established a foothold in Belgium a full staff from their observatories was on hand to take up their work in observatories at Liége, Brussels and other places, where they have performed most efficient services for their forces by predictions relating to the weather, particularly in regard to fogs; and this information has been shown to have been of decided value both in the operations of the air fleet and to the submarines as well. This has been demonstrated by the results of the raids by the Germans on Scarborough and Hartlepool, and the operations of the submarines in the Channel, all of which have depended largely on fog conditions for their success. At these observing stations the weather men have not depended altogether on the equipment they found, but have supplemented that by improved instruments they brought with them, and by the use of the testing balloons which they have made use of extensively.

**The Soldier's Chances in War.**—Basing his estimate on the death rates of the Union army in the Civil War, the German army in the Franco-Prussian war, the British army in the Anglo-Boer war, and the Japanese army in the Russo-Japanese war, Edward Bunnell Phelps, editor of the *American Underwriter*, says that the loss by death in the present war will be 540,000 if the average number of men engaged during the year amounts to 6,000,000, which is something more than the total annual death rate for the entire adult male population of the United States. But this does not prove that the life of a soldier is much more uncertain than that of a civilian under certain conditions. Thus Mr. Phelps finds from the American Experience Table of Mortality that a soldier's chances of living through a year of the war are greater than those of a civilian for living from the age of 25 to the age of 36, from 30 to 41, from 35 to 45, from 40 to 49, from 45 to 52, from 50 to 56, from 55 to 60, or from 60 to 63 years.

**War has Lost Its Luster.**—In spite of the enthusiastic descriptions written by correspondents far from the scene of action, the fact is that war has lost its luster, and the spectacular side of war has been abolished by the changes of time; in fact, war has become stupid. As a writer in the *London Times* tells us: "The general no longer rides at the head of his legions, if indeed he ever rides at all. Far in the rear, almost out of sound-range of the guns, he directs, if we can call it directing, the movements of his armies. Near by in some field the masts for the wireless; in every direction airlines and cables; in some inner room, poring over the map set out by the operations branch, the commander-in-chief, endeavoring to piece together news and to make things as unpleasant as he can for his distant enemy. In the field, no more the clatter and jingle of the squadrons. Trenches and always trenches, and nothing showing above the surface of the ground. Day after day the butchery of the unknown by the unseen, and events decided by the greatest mass of projectiles hurled simultaneously in the general direction of the enemy." The thundering charge of infantry has become more ghastly than glorious, for in the face of a devastating fire by every description of weapon, and innumerable mines and entanglements, few of the attacking force survive, and the result, at least on the western front, is merely an advance of a few feet and the capture of a few hundred yards of trench in a line hundreds of miles in length.

## Science

**Work of the "Carnegie" in High Latitudes.**—The non-magnetic ship "Carnegie," belonging to the Carnegie Institution's Department of Terrestrial Magnetism, spent last season cruising in high northern latitudes and is to make a longer cruise in 1915-1916 to high southern latitudes, viz., between the 50th and 75th parallels, which will take her far into the Antarctic. On her last trip she sailed from New York, June 8th, 1914, and traveled about 10,600 miles, touching at Hammerfest, Norway, reaching latitude 79 degrees 52 minutes north-west of Spitsbergen, thence proceeding to Iceland, and ultimately making magnetic surveys in Hudson Bay. She returned to New York in October.

**Agricultural Alcohol.**—Some years ago the U. S. Bureau of Plant Industry began an investigation of the problem of utilizing the waste and surplus products of American farms as a source for the manufacture of denatured alcohol. Dr. Edward Kremers, of the University of Wisconsin, was sent abroad as a special agent to study the development of this product, especially in Germany, and his report has just been published as Bulletin 182 of the U. S. Department of Agriculture. German agriculturists have devoted a great deal of attention to finding new industrial outlets for alcohol and to improving and popularizing existing outlets. Potatoes are the great source of alcohol. About 6,000 agricultural potato distilleries were in operation in Germany at the time of Dr. Kremers's investigations.

**The Size of Seed as a Factor in Plant Production** is the subject of a report by M. B. Cummings, of the Vermont agricultural experiment station, in which the author describes experiments in planting sweet peas and a number of garden vegetables. There is, on the whole, a decided advantage in using large and heavy seed. Thus sweet peas from such seed were earlier in blooming, bore more and finer blossoms, and were generally more thrifty. The results were not uniform for all the species tried; but all showed some effect of the size of seeds except garden peas, when harvested as green peas. When these peas were allowed to mature, large seed gave slightly better results than small seed. A subsidiary investigation related to the location of large and small seeds in the pods of peas and beans. In the latter, 49 per cent of the small seed were found to occur in the basal end, while only 18 per cent occurred in the middle of the pod. In garden peas the small seeds were almost always found at the ends of the pods.

**The Journal of Agricultural Research,** published by the U. S. Department of Agriculture, recently entered upon its third volume, and at the same time opened its columns to contributions from the agricultural experiment stations. This important publication was founded for the purpose of bringing together the more technical research papers prepared in the department. Such papers were previously issued in the "bulletin" series of the several bureaus and offices of the department, along with papers of a more practical character. The number of these series caused the more advanced scientific memoirs to be scattered through an immense literature, and tended to make them difficult of access. An analogous situation has heretofore existed in connection with the voluminous publications of the agricultural experiment stations, though in some states the more technical publications have recently been segregated in separate series of "research bulletins." Hence it has been decided to publish a single journal in which the product of the two principal agencies for agricultural research in this country—viz., the Department of Agriculture and the experiment stations—can be presented promptly to the world in a form suitable for preservation.

**The Migration of Tuberculous Persons** in the United States, and its effects upon the public health, has been the subject of elaborate investigations by the Public Health Service for nearly two years past, and the work has now been completed in several states, while it is still in progress in others. Studies made in southern California in 1913 and 1914 showed that 17.8 per cent of deaths from tuberculosis in that section occurred within one year after arrival in the State; indicating that many tuberculous persons leave their homes for health resorts under conditions that are clearly contra-indicated. Little or no evidence was obtainable to show that the migration of tuberculous persons has any decided bearing on the health of other travelers or of the employees of railways and other common carriers. One striking result of the investigation in southern California is that the presence of tuberculous persons who have migrated to this section has, as a rule, had a beneficial effect on the health and social and economic status of the various communities. Many communities in southern California have been built up by migrating consumptives, and important enterprises have been originated by them. The only communities in which the public health has suffered are those to which large numbers of far advanced and hopeless cases resort without adequate financial resources; such consumptives are generally more careless in their personal habits and necessarily reside in cheap rooming and boarding houses.

## Automobile

**British Cyclecar With Novel Points.**—One of the latest "cyclecars" or "light cars" manufactured in Great Britain, possesses a number of unusual features, not found in any other automobile made. It has a 4-cylinder motor with both valves and spark plugs set horizontally into the cylinder heads; a full steel casting in the form of a pan, which forms the forward end of the chassis; a mechanical starter which works on the principle of a ratchet screw driver or drill, and a new type of cantilever spring which is said to possess unusual flexibility and resiliency.

**Motor Trucks Dominate Automobile Exports.**—Stories of huge exports of motor trucks for the warring nations, which appeared early last fall, are borne out, at least partially, by the export figures for the month of December, 1914, which show more than $3,000,000 worth of "commercial" motor vehicles shipped abroad. France took two thirds of this total and Great Britain the remaining third. Shipments to Russia are held up at present because of the impossibility of getting anything through the ring of ice which surrounds the North Russian ports.

**2,500,000 Motor Cars in 1916.**—That on January 1st, 1916, there will be two and one-half million automobiles in the United States, appears a somewhat wild prediction, when it is considered that there are only about 600,000 automobiles in the whole world, outside of this country. Figures collected from the various States of the Union show that on February 1st, 1915, the number of registered cars exceeded 1,900,000, and the growth in the last 13 months has been equal to not less than 600,000 per year. As the rate of increase during the individual months has been much greater toward the end of 1914 than in the early part of that year, it seems certain that fully 600,000 cars will be added between February 1st, and December 31st, 1915.

**Radiators for Power Wagons.**—Of the various types of radiator which are found suitable for power wagon use, the smooth tube type is used extensively on recent cars of French build. The two water holders of the radiator are connected across by flat tubes placed side by side so as to present the edges to the air current of the fan, or in other cases the radiator uses a great number of round tubes of very small section (0.2 inch). The first method is used in the Berliet wagon, while the Renault employs the latter. Among smooth-tube make-ups, the Goudard and Menneson merits special mention, and it was the type preferred for the Paris autobus, besides being in use on De Dion, Schneider, Delaugére, and other cars. An air fan is mounted inside a drum formed by a top and bottom water holder joined by circular tubing. Such tubing has five rows in width and the same number in thickness, that is, the part occupied by the tubing has a square section, with 25 tubes. The air fan is designed so as to draw in air on each side of the fan, and drive it out from the edge, and it thus passes through the set of tubes, which thus receive a strong draught. Hot water from the motor enters the top receptacle and after descending through the tubes it collects in the bottom holder and returns to the motor. One point about this type of radiator is that as the tubes are curved, they become stronger and chances of breakage are less. On the road, should a tube break, it is an easy matter to remove it and stop up the two holes left, and the radiator works as before. Gravity water cooling can be employed in this type without the air fan, as it will work well either way.

**Motor Laundries at the Front.**—The latest use to which the automobile has been put by the warring armies of Europe is that of a laundry for the field hospital corps. The laundry consists of four vehicles, the leading one being a very powerful motor truck on which is mounted a steam mangle, which is easily removable. The second vehicle in the train contains a complete steam plant with boiler, turbine, drying cabinet and disinfecting tank. The third truck carries the washing machine itself, centrifugal drying drums, pumps for hot and cold water and a condenser for steam when the ordinary water of the neighborhood is too hard to be used for washing. The fourth truck is loaded with soap, soda, coal, gasoline and tools. On the march all four trucks are coupled together, while at the points of the battleline, where the hospital has been erected, they are arranged in the shape of a horseshoe. The entire "laundry" can be covered by a large tent. When in use, the train requires the attention of twelve privates and one non-commissioned officer. The motor truck, as soon as the steam mangle is removed, is used to carry laundry to and from the hospital. Bloody linen is first thrown into the disinfecting tank and boiled with strong soda and creosote soap. The drying cabinet is for woolen wear which is difficult to wring dry in the mangle. The capacity of such a laundry is about 3,000 pounds of assorted dirty linen daily. It has proved a tremendous success at the field hospitals on the German side, and has greatly reduced the work of the sanitary corps, with far greater cleanliness and efficiency.

## Tests of Armor and Projectiles

Leading down from the turret of a battleship through the protective deck is a tube known as the ammunition tube, through which shells and powder for the turret guns are brought up from the magazine. As this is a vital artery in a fighting ship the tube should be proofed against the shells of the enemy. Herewith is a photograph of two steel ammunition tubes, the one at the left being of a special armored steel developed at the Hadfield Works, in Sheffield. The tubes are shown after having been attacked by an 8-inch capped armor-piercing shell fired at a velocity of 1,400 foot-seconds and developing a striking energy of 3,600 foot-tons. The Hadfield tube was neither perforated nor cracked, and the projectile that struck it was shattered without doing the shell any material damage. Had the shell been loaded with a high explosive filler it would have burst harmlessly outside the tube.

To the right, in the photograph, is an expensive, forged, hydraulic-pressed, oil-tempered, nickel-steel tube. When an 8-inch shell was fired at this tube it pierced the target, fragments of the shell passing through the tube. The tube was cracked, as the photograph shows, and as it was perforated the shell, which was not broken up by the impact, would have burst inside the tube had it been loaded with the customary high explosive filler.

On this page we also show a picture of a 12-inch armor-piercing projectile after undergoing the test of passing through 12 inches of Krupp steel. Note the spiral scoring on the surface of the shell showing its rotation.

A 12-inch shell after having passed through 12 inches of Krupp steel.

## Nerves and the War

A German scientific periodical, *Die Umschau*, recently published an article by Dr. A. Eulenburg on the changes wrought by the war on the nervous system of the combatants and the non-combatants who are subjected to the usual anxieties attendant on war.

Dr. Eulenburg opens the article by stating that the most popular German army commander, the general in charge of the Russian campaign, who was created a field marshal a short time ago, and is presumably von Hindenburg, expressed the opinion in a recent interview that the war (against Russia) resolves itself into a question of "nerves," and as the Germans have the better nerves they eventually will win. While coinciding in this view, Dr. Eulenburg thinks it opportune at this time to examine and consider the effects which six months of war have thus far produced on the nervous system of the nation, considering both those in the field and those who remain at home. From all reports and from extensive personal observations embracing participation in a number of campaigns, Dr. Eulenburg is convinced that in healthy individuals, endowed with a normal nervous equipment and having the requisite resistance, the so-called war neuroses are not a factor to cause alarm. On the contrary he considers war with all its physical and psychical impressions and experiences as a powerful salutary medium, a purifying, hardening and rejuvenating remedy for nerves which have become enfeebled and sluggish during long years of peace. Neither the leaders of the army nor the rank and file have thus far shown the slightest signs of exhaustion or nervousness of any sort. In spite of all the hardships and terrors of warfare, the severe physical exertions and exposures, the rigorous life in the trenches, the troops have maintained their vitality splendidly as well as their courage and their good humor.

In view of these illuminating facts we may accept the conviction that a so-called war-psychosis in the sense of a pathological condition caused exclusively by the incidents of war does not exist. Whenever cases of war nervosity, of neurasthenia, or other psychoses develop, which happens not infrequently, they, with the exception of those resulting from severe wounds to the head or brain, may always be traced to a predisposed psychopathic constitution. In these cases of unstable nervous balance the impressions and terrors of war act as the exciting cause. Thus the cases which were frequently observed in the war between Russia and Japan and in the Balkan wars are explained in the same manner, and no evidence whatever has thus far been adduced that perfectly healthy individuals have ever suffered from nervous disturbances caused by the war itself.

The term war psychosis has been defined by Buschan as a form of cerebral neurasthenia accompanied at times by hysterical symptoms, delusions, and even complete insanity. It invariably develops in persons who are constitutionally predisposed. The clinical picture presents increased irritability, exhaustion and great mental depression. The prognosis in the majority of cases is favorable, recovery being gradual with a disappearance of symptoms.

Another form of psychosis known as fear neurosis is observed most frequently in recruits who have not yet seen service. Occasionally it is observed in those who have been in the field and are temporarily relieved or discharged for purposes of recovery. The patients suffer from sleeplessness, hysteria, an exaggerated sense of fear and terror which at times becomes unbearable and even drives the victims to suicide. Of course these cases are not suitable for service and must be removed at once. Neither an appeal to reason nor the employment of sedatives or narcotics seems to have the slightest effect upon them. Generally the only thing to do with these poor victims is to place them in suitable sanataria, where by time and the requisite care their shattered nervous system may be restored to normal.

Then there are cases in which the nervous disturbance takes the form of a mania or hypomania. These are characterized by great mental excitement, an increased bodily activity and an irresistible desire to talk or write. This condition may be overlooked at first, but when recognized demands prompt remedial measures for the good of the afflicted as well as the service.

Dr. Eulenburg insists that these morbid conditions are in no respect due to the effects of the war, but their cause must be looked for in long existing predisposition of the individual and in a psychopathic constitution. In other words in an enfeebled nervous system unable to bear the trying and strong impressions of the war.

Still more sad, however, is the condition of those men and women who are obliged to remain at home, who are condemned to patient endurance and anxious waiting, whose emotions are always on edge, whose nervous system is always under a strain, experiencing sorrow and happiness by turns, one moment depressed by grief, the next elated with joy; always wrestling with doubt, fear and uncertainty.

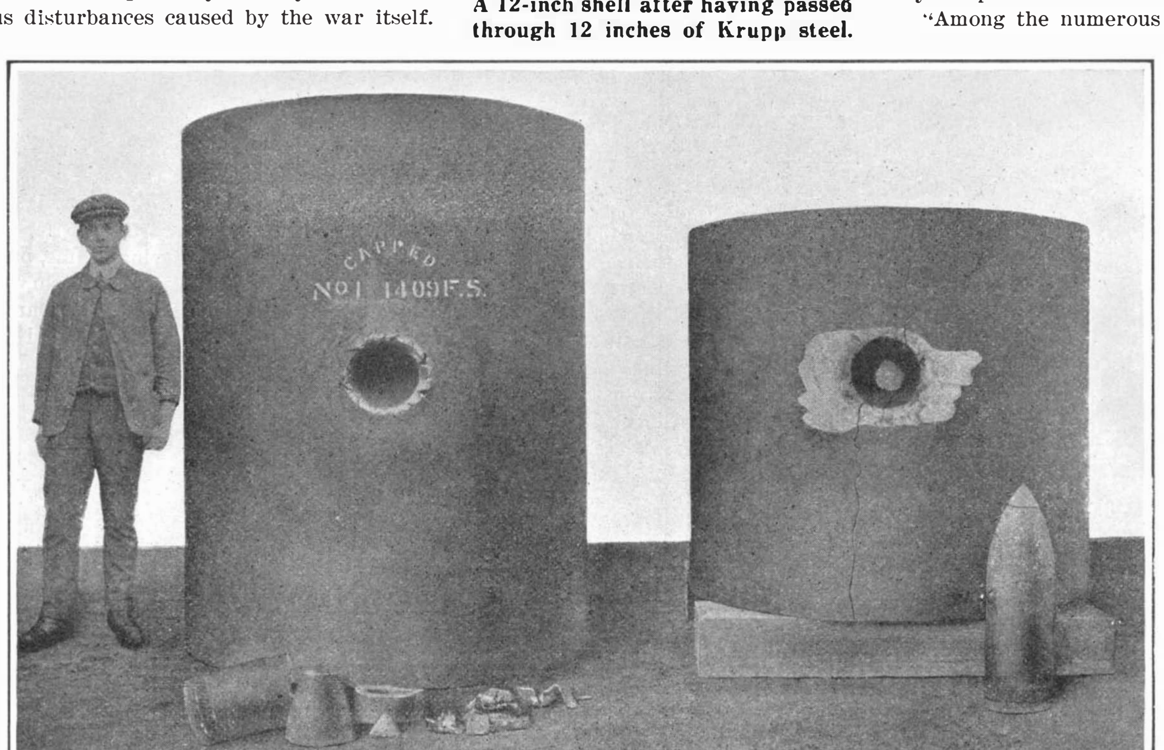
These depressing, nerve destroying emotions leave their impress permanently or otherwise according to the condition of the nervous system of the individual. Many succumb to the demons of doubt and despair.

This class furnishes the true martyrs of war, the real victims of war neuroses. They require our greatest sympathy and our most considerate care.

Whatever may be the experience of this war—and it is still too early to draw any conclusions—there was evidence enough gathered in our own civil war, that fierce battles produce nervous disorders. A hospital for neural disorders was created at Turner's Lane, near Philadelphia in August, 1862, and pavilions were built for four hundred men. It was in charge of the late Dr. S. Weir Mitchell, whose interest in nervous diseases was aroused while he was working as an army surgeon. In a fascinating address delivered before the Physicians' Club of Chicago on February 25th, 1913, in which he discussed the medical department of the civil war, Dr. Mitchell said:

"The cases were of amazing interest. Here (at Turner's Lane) were eighty epileptics, every kind of nerve wound, palsies, singular choreas, and stump disorders. I sometimes wonder how we stood it. If urgent calls took us back into town, we returned to the hospital as if drawn by a magnet. In fact, it was exciting in its constancy of novel interest. Thousands of pages of notes were taken. There were many operations, many consultations, and toward the close we planned the ultimate essays which were to record our work. Each of us took his share, but all three were mentioned on the title pages of our essays. There was a small book on nerve injuries and an essay on reflex palsies, both of which I wrote. Dr. Keen contributed an admirable paper on malingering. . . . Our notes on epilepsy were very full, and there were things recorded which I have never seen since or seen but once. . . . Our notes and conclusions in cases of acute exhaustion and extreme myasthenic conditions would have entirely anticipated the delineation of those orders which we now accept under the name of neuresthenia. . . . In this hospital massage was used to restore action to limbs in which healing nerve wounds left the muscles palsied, or for the rigidity of splintered cases.

"Among the numerous other matters . . . were the influence of nerve lesions on nutrition and temperature, the first record of wounds of the sympathetic nerve and the study of reflex palsies. The victims of nerve wounds were often men worn out from fever, dysentery and long marches; hence some of the symptoms of nerve wounds we described have never been seen since in like intensity. That hospital was, as one poor fellow said, a hell of pain. In one year over 40,000 injections of morphine were used. Time lacks here to re-describe cases of neuralgia of such intensity that the pain was increased by the vibrations of a band of music, by the rustle of dry paper handled, and by a loud footfall in the ward. I have seen men pour water into their boots to lessen the vibration which walking caused. I have never encountered such cases since."



Effect of 8-inch shells fired upon armored steel ammunition tubes.

## Making Clothes for the German Army

A NUMBER of industrial works in Greater Berlin, mainly belonging to the metal, wood, leather, food, and clothes industries, are at present engaged on a large scale in the making of articles for war use. One of the accompanying views shows how a series of sewing machines, connected together by a nearly invisible common shaft and operated from the top by an electric motor fixed to the wall, are producing knapsacks and cartridge boxes out of ready-cut leather pieces. In another picture we see the manufacturing of pouches for field telegraphs. The material prepared beforehand is cut into shape on cutting machines and finished on punches, drilling machines, etc. The cutting of "field-gray" cloth for uniforms and cloaks is likewise done on electrically driven machines.

## How Electricity Makes the Iron Cross

THE Iron Cross, a decoration created in 1813, at the time of the German Wars of Liberation, and revived in 1870, during the Franco-German War, is the most highly prized recognition of valor in the present conflict. While the decoration and the spirit animating those on whom it is conferred have remained the same as one hundred years ago, typically modern methods have been adopted in making the crosses. In fact, an extensive use is made of electrically operated machinery for the various stages of manufacture at the workshops intrusted by the German army authorities with producing the Iron Cross.

Iron Crosses are by no means produced by casting. Rectangular pieces of sheet iron stamped out with a punching machine are struck with steel dies on powerful presses, in accordance with the rules laid down by the Order Committee. One of our views shows two such coining presses in the foreground, each of which is provided with a big electric driving motor, while in the background is seen the punching machine, the motor of which is carried by a bracket on the ceiling.

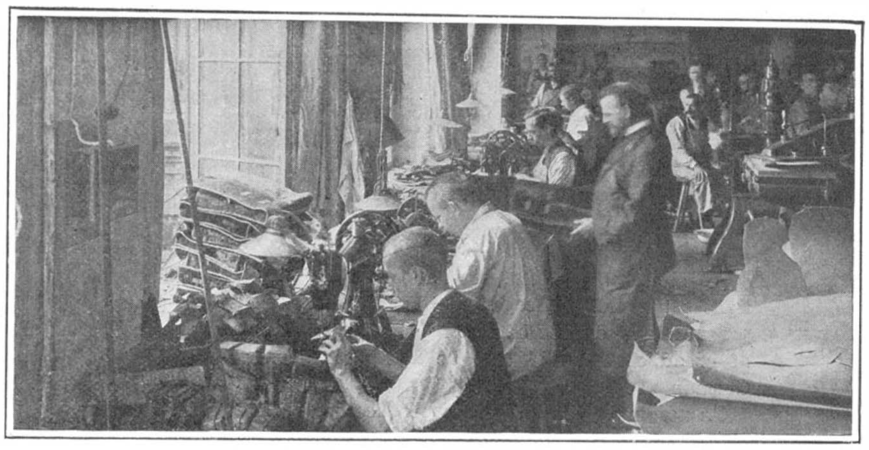
After being thus prepared and tested, the Iron Crosses are taken to the silversmith's, where the soldering is done, a fine silver border added, and the finishing completed. A second illustration shows how the silver border surrounding the Iron Cross is polished on electrically driven polishing and grinding motors.

## Clothing a Winter Army

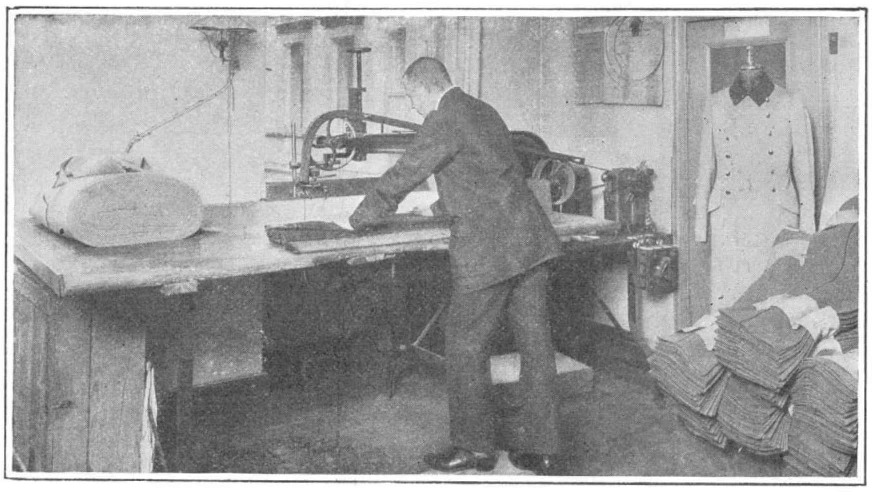
AS with everything else pertaining to an army, its clothing is primarily one of the duties of the General Staff. The watchfulness of nations against one another has resulted in an intimate knowledge of the number of men actually on duty, every arm adopted, each piece of new equipment, the resources of the country in every particular, and the probable mode of procedure to meet each hypothetical condition developed into actualities.

Naturally the *raison d'etre* of an army is defense, and defense means war; peace times are used in preparation for war, and in the days of peace the General Staff is engaged in working out each detail of possible war, reducing the results to paper, carefully checked and proved, and then filing them away against the time of need. War is planned on paper against every possible enemy; the duration of the war is carefully estimated, and in the estimate the seasons are considered and the comfort of the soldiers; for while the entire object of maintaining an army in the field is to get the most men available up on the line of battle, by far the greater work is to be found in caring for the men in the intervals between combats, that they may be in condition to fight when the time comes.

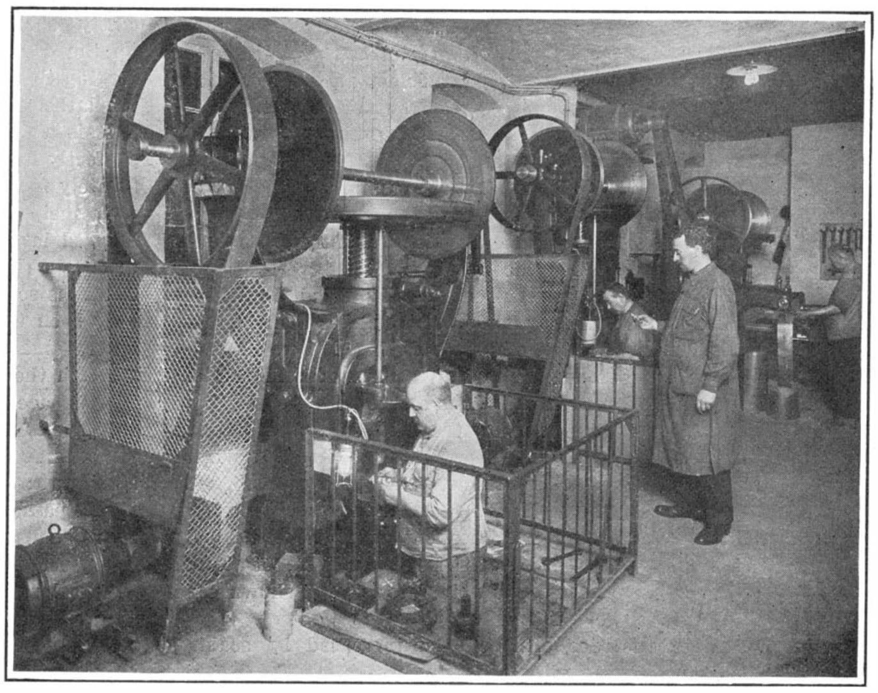
It is therefore perfectly safe to say that the present war which is devastating Europe has been fought out in more or less detail in the long days of study in days of peace. And in the fighting out, the



**Electrically operated sewing machines for manufacturing knapsacks and cartridge boxes.**



**Cutting uniforms with an electrical knife.**



**How the Iron Cross is made with electrically driven punches and dies.**

**Polishing the silver borders of Iron Crosses on electrically driven polishing and grinding machines.**

problem of raising and maintaining stupendous armies has been worked out, the feeding of the armies, the supply and the clothing as well, with special regard to the chill ravages of winter in the field.

Take Germany, for instance. The German staff knew almost to a dot how many men could be turned out in defense of the empire. The staff knew almost the exact day when a certain number would be formed in the ranks; and in anticipation, clothing was ready for them, shoes, equipment and arms, stored away in warehouses where they could be brought to light with little or no confusion. Probably not five hundred persons in Germany outside the staff had ever seen the new field uniform of the German army until it was issued upon the tocsin call to arms last August; yet it was there.

Germany is, justly, accorded the highest and most complete military organization of any country which has ever been in existence. It may therefore be taken as standard, yet the other military nations, such as France, Russia, and Austria, are not far behind in completeness of preparation, and it is a fact that every resource has been computed for each eventuality. Consequently, long before war became more than an ever-present possibility, plans were completed in each country for clothing the soldiers, and with the declaration of war, the call to arms, the wheels of the clothing organization were set in motion, not to stop until the necessity for their grinding ceased.

Let us take a hypothetical country, declare a war and set the wheels to going. Utopia has declared war against a neighbor. Four million men will spring to arms, expanding from an army with a peace strength of 600,000. In anticipation, the staff has long ago caused the manufacture of 4,000,000 uniforms and equipments. As mobilization progresses, the storehouses are opened and over the railways, automatically brought under the direction of the military with the declaration, they are shipped to the various points.

The theater of war has long been known, as well as the probable duration of conflict. In accordance with the plans, based upon experience, observation of other countries at war, test, and always common sense, the staff well knows that the first equipment of clothing will not last over three months at the most of arduous service in the field, when one outer uniform is all that may be carried afield. The men have no change of uniforms; the marches take place alternately under burning sun, drenching rain or chill, and clouded day. Rivers are to be waded, breast high; mud-plastered trenches are to be occupied; grinding, cutting dust of a hot march is to be encountered, and the rough wear-and-tear of a campaign will surely reduce the material to a most thoroughly worn out condition in a short time. The shoes, most important articles to a soldier, receive constant wear; for they are seldom off the tired feet, and alternate wetting and drying play havoc with the leather.

The staff, then, knows that all this clothing must be replaced within three months. In addition, the reserve classes which are to be called to reinforcement must be clothed. Casualties will occur, and there must be fresh clothing to replace that so lost; although frequently the bodies of the dead are stripped, through necessity, and the clothing thus removed saved for issue to another new man, sometimes with a small bullet hole through the breast pocket and a dull stain around it. War does not make for squeamishness.

As the railways are seized upon war's outbreak, all the clothing factories of the land are assigned certain work to be performed. Either bids are called for or a just, flat price is fixed by the staff and a certain amount of work assigned to each house, willy-nilly.

Four million overcoats must be ready by the first of November, say. The houses which have the wool and other material

*(Concluded on page 232.)*

## German Agriculture in War Time

By the Berlin Correspondent of the Scientific American

THE present war places before German agriculture a number of problems which it is confidently hoped will find a satisfactory solution. The dearth of hands will no doubt be met by recourse to female and volunteer labor, as well as by a temporary reflux of workmen from the cities into the country, so that there may not be any serious difficulty in this respect. Apart from this, there will, however, be a scarcity of certain commodities heretofore imported from abroad, of which German agriculture stands in urgent need for fertilizing the fields of the country, and these will have to be replaced by convenient substitutes.

Prof. Gerlach of the Emperor William Institute of Agriculture, Bromberg, Germany, has worked out some valuable suggestions for the manuring of the German fields in the absence of foreign fertilizers, which it seems will allow the present crisis to be met successfully. In order to appreciate the extent of the problem, it should be remembered that Germany in 1912 consumed 750,000 tons of Chili saltpeter, 425,000 tons of ammonium sulphate, 50,000 tons of lime nitrogen, and 50,000 tons of Norwegian saltpeter. To this is to be added the nitrogen contained in non-unglued bone meal, Peru guano and other nitrogenous fertilizers, the amount of which, however, remains far behind that held in the above materials.

Though the manufacture and use of ammonium sulphate, and even more that of lime nitrogen, have during the last two years undergone a considerable increase, Prof. Gerlach is of the opinion that half the nitrogen spread on the fields in the form of concentrated fertilizers is still Chili saltpeter. According to a conservative estimate, about 200,000 tons of nitrogen per annum would seem to be utilized in this way by German agriculture. When distributing this uniformly over the whole area of fields under cultivation a consumption of 7 to 8 kilogrammes per hectare is obtained, though present tendencies are toward a further increase of this amount. By far the greater part of the nitrogen, especially saltpeter nitrogen, is employed in the spring, from March to May. If, accordingly, the war should continue until next spring, the greater part of the indispensable nitrogen would be wanting. The German ammonia and lime nitrogen industry will doubtless endeavor to make up for the deficit, in which connection it will certainly be encouraged by the government. On the other hand, two to three times more saltpeter may be expected from Norway than in 1912, the manufacture of this product having in the meantime made great strides.

How indispensable is the use of soluble nitrogen compounds can be inferred from the following: One hundred kilogrammes of Chili saltpeter will enable the yield of rye fields to be increased by 400 to 500 kilogrammes per hectare. This corresponds to a total of 2,500 to 3,000 millions of kilogrammes for the total area of German rye fields (in 1912), viz., 6.14 millions of hectares. Similar results can be obtained by means of ammonia salts or lime nitrogen, and a similar calculation can be applied to the remaining cereals, to potatoes and turnips. In fact, nitrogen is the vegetable food exerting the most striking influence on the yield, and no other manure can be fully utilized if there is a deficit of efficient nitrogen compounds in the soil. On the other hand, there can be no doubt that those artificial nitrogen fertilizers at present in the market are very suitable substitutes for Chili saltpeter, Norwegian saltpeter, e. g., being absolutely equivalent to the natural product.

According to Dr. Gerlach's suggestions, the available amounts of Norwegian saltpeter should be used primarily as top manure for the rye next spring and for the beet-roots. For the rest, he recommends the following top manuring for the spring of 1915: Rye in rye soil proper, that is, in light loamy sand, should, in the spring, receive 20 to 30 kilogrammes of saltpeter nitrogen, as top manure, unless stable or green manure is used. The same applies to the dark alluvial soil of the lowlands. In case of a dearth of Chili or Norwegian saltpeter, Dr. Gerlach suggests substituting for the above quantity of nitrogen either ammonium sulphate (100 to 150 kilogrammes) or lime nitrogen (150 to 250 kilogrammes per hectare), both fertilizers being applied as early as possible in the spring. In the case of wheat, the dose of nitrogen can be frequently reduced, on account of the better soil and more satisfactory conditions, 15 kilogrammes per hectare (corresponding to 75 kilogrammes of ammonium sulphate and 100 kilogrammes of lime nitrogen, respectively) being mostly sufficient. The excellent effects exerted by saltpeter on the development of oats are well known. Ammonium sulphate has also in this case given good results, 150 kilogrammes per hectare being generally sufficient. Barley does not always require nitrogen fertilizing; in the case of middling ground, 75 kilogrammes of ammonium sulphate or 100 to 150 kilogrammes of lime nitrogen will be sufficient.

Stable manure should preferably be reserved for potatoes. In case of an abundant use of animal manure (200 to 300 kilogrammes per hectare) no special nitrogen fertilizers will, as a rule, be required. Beet-roots, however, even in animal manure, cannot dispense with nitrogen fertilizers, 300 to 400 kilogrammes of Chili saltpeter or the corresponding amounts of artificial fertilizer being generally used.

Should it be absolutely impossible to provide the necessary amounts of nitrogen fertilizer by next spring, a reduction will, of course, have to be made. This, however, should, as far as possible, be avoided with rye in light soil, where nitrogen fertilizing is the most indispensable and cannot be made up for later on. A deficit of bread corn would also be felt most keenly by the German people.

On account of the great importance of artificial nitrogen fertilizers destined to serve as substitutes for Chili saltpeter, both the government and private parties will promote their production. Should there, however, be no possibility of making up for the deficit, there would, of course, be a reduction in the yield of cereals, but the country would not by any means be brought to the verge of starvation. In fact, Dr. Gerlach estimates the deficit of corn, in the worst possible case, that is, if there should not be even a partial compensation, at about 1,000,000 tons, viz., barely 4 per cent of the total crops. It is true that, on account of the partial or total cessation of imports, even this deficit would be keenly felt.

As regards the question of potash fertilizing, German agriculturists need not entertain any fear, the production of potash salts continuing undisturbed. Even in the event of there being a deficit of nitrogen the amount of potash fertilizers should not be reduced, these materials being relatively cheap, while any potash not absorbed mostly remains in the soil.

Whether German industry will be able to provide the full amount of phosphorus fertilizer needed by the country cannot yet be said. The production of Thomas meal continues, and since the German iron works are kept very busy considerable quantities of this valuable fertilizer will be brought on the market. On the other hand, it is doubtful whether sufficient amounts of crude phosphates and pyrites for the manufacture of superphosphates may be available, the larger part of these materials having so far been imported from the United States, Algeria, Belgium, Portugal, and Spain. In the event of a deficit the use of these manures would, of course, have to be reduced, which in many cases could be done without any inconvenience.

The Prussian government has granted individual agriculturists and agricultural societies considerable loans for the erection of potato drying plants, of which a large number are already in course of construction. Two hundred new installations are to be added to those so far in operation, so that the greater part, if not the whole, of the potatoes left unused during the winter may be dried. Three products will be marketed, viz., potato flakes, potato shavings and compressed potatoes, all of which constitute excellent, durable and handy fodder. The digestibility of these products is not altered by the drying process and actual tests have shown each of them to be utilized to the same extent. Their nutritive qualities can be even increased by soaking them in skimmed milk, whey, or water.

## Germany's Nitrate Supply

A FRENCH Senator, in calling attention to the probable diminution in agricultural crops, in Germany and Austria, caused by the cessation of the imports of Chili saltpeter, amounting to 750,000 tons annually, recently asked how the supply of explosives would be affected. A writer in *Le Temps* gives the following conjectural answer:

It is probably not far from the truth to estimate the consumption of explosives, by each group of belligerents, at 400 tons per day, or 150,000 tons per year. In practice from three to ten tons of nitric acid are used in making one ton of explosive. Assuming five as the average proportion, we arrive at an annual consumption of 750,000 tons of nitric acid.

The available sources of supply are the following: In Bavaria, and at Innsbruck, in the Austrian Tyrol, are two factories which produce nitric acid from the atmosphere. Their combined power is 65,000 horsepower, which, if completely utilized, would produce 30,000 tons of nitric acid per year. A factory in Westphalia annually produces 1,500 tons of nitric acid by the Ostwald process, in which the ammonia evolved by coke ovens is oxidized in presence of platinum. This interesting method has probably attracted the attention of German chemists, especially in present conditions which make the cost of the product relatively unimportant. The production of nitric acid in this way may have been increased tenfold since the war began, but it cannot have been increased a hundredfold.

The French bacteriological method of Muntz and Lainé, which consists in sowing great beds with nitrifying bacteria, is capable of yielding 500 tons of nitric acid per hectare (2½ acres), but several months elapse before the beds begin to produce regularly, and the yield is greatly diminished in winter. Hence, this method is not likely to be employed.

The total annual supply of nitric acid obtainable from the domestic sources enumerated above may amount to 50,000 tons, or one fifteenth of the consumption. The deficiency would not be supplied even if all of the nitric acid produced in Norway by the Birkeland process, about 400,000 tons per year, should pass into the hands of Germany and Austria—a very unlikely supposition.

This is a French view of the situation. We have more confidence in the ingenuity of the German chemist to meet the requirements of the situation.

## Forging the Inner Tube of a German 16½-inch Siege Gun

THE ability of the Krupp works to turn out 16½-inch siege guns possessing a certain limited amount of mobility, is due partly to the undoubted skill of the designing department and even more to the great advances which have been made of late years in the art of gun-steel manufacture. The prime consideration in building a 16-inch siege gun for field operation was to reduce the weight to the lowest point compatible with the requisite strength. The Germans have not given out any details regarding this piece; but this much is certain, that in order to make such a gun practicable, it was necessary to employ low pressure in the powder chamber and to make the gun barrel of a special quality of steel, embodying great tensile strength in proportion to its weight. Probably the barrel is forged from one of the new steel alloys from which such remarkable results have been obtained in the various arts, and particularly in gun manufacture. Our own Lieut. Cleland Davis used for the barrel of his torpedo gun a vanadium-steel alloy, from which he obtained excellent results. Possibly the Germans are using an alloy of this or kindred character for the 16-inch siege gun.

The production of gun-steel is a long and tedious and costly process and calls for the greatest care in making up the composition of the steel, in casting it, and in forging the ingot to the required rough shape ready for the lathe.

It is a prime requisite in gun steel that it shall be perfectly homogeneous throughout. Also it must be absolutely free from irregularities due to segregated material, incipient flaws, seams, etc. These qualities are secured largely in the process of forging, and in order to obtain that thorough working of the material which conduces so greatly to its toughness and strength, it has long been the practice to forge the gun barrel upon a central mandrel which is inserted in an axial hole through the forging, when it is brought white-hot from the furnace and placed in the hydraulic press as shown in our illustration. The material is squeezed between the mandrel and the press, the ingot being given a slight turn between each squeezing, by means of a chain which passes around the forging and is operated by the gears shown in the upper bight of the chain. Gradually the piece is reduced in diameter and drawn out to proper length, until the desired final size of the rough gun barrel is reached.

## The Current Supplement

THE leading article in the SCIENTIFIC AMERICAN SUPPLEMENT, No. 2044, for March 6th, is a most valuable paper by Dr. George M. Gould on A System of Personal Biographical Examinations the Condition of Adequate Medical and Scientific Conduct of Life, that will be found of interest not only by the layman, but especially so by the medical profession, as it discusses one of the most vulnerable features of medical practice. The account of the experiments in registering radio time signals with a physiological recorder gives an interesting account of the application of frog dissections for detecting slight impulses. Reproductions of the records are given and illustrations of the apparatus. Experiments with Flying Boat Hulls gives some of the results secured in experiments made in the model basin at the Washington Navy Yard. Snag Boats on Flood Rivers tells how snags get into rivers and the methods adopted by the Government to remove them. Several instructive illustrations accompany the article. Electroculture of the Soil is a valuable discussion of a topic that is attracting wide attention, as it deals with the electrical processes in biological reactions. The illustrated description of the hydraulic mining cartridge and its various applications and the results obtained tells of a very efficient mechanical device for breaking down minerals where it would be dangerous to use explosives. A timely article is a report of the Committee on Resolutions of the Snow Removal Conference, held at Philadelphia in April, 1914. This is a subject of interest to the citizens of every city in the country within the snow belt. Other articles are German System and Method, telling what their industries are doing since the war began; Electric Waves and Oscillations as a Means of Investigating the Interior of the Earth; Diseases Dangerous at Different Periods of Life, and a number of shorter articles.

# Correspondence

*[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]*

## Congress and National Defense

To the Editor of the SCIENTIFIC AMERICAN:

Let me congratulate you on your "War Issue No. 5," dealing with "Our National Defenses."

The conditions responsible for the present state of our national defenses are, to my mind, ably set forth.

I, for one, trust the day is not far distant when all of the various creeks will have received their necessary appropriations, when all of the squash centers will have their public buildings, and our Congress will feel that they have the time and the means to pay a little attention to the most vital matter of our national welfare.

Neche, N. D. FRED. L. LEWIS.

## Comparative Fighting Value of Fighting Ships

To the Editor of the SCIENTIFIC AMERICAN:

I do not think Mr. A. Given's system of calculating the fighting value of battleships is correct. Details of the principal ships he mentions are as follows:

| Name | Tonnage | Speed | Guns Ins. | Broad-side | Belt Ins. | Units |
|---|---|---|---|---|---|---|
| "Iron Duke". | 25.400 | 22 | 10—13½ | 10 | 12 | 3,426 |
| "Kaiser" .... | 24.700 | 23½ | 10—12 | 10 | 14 | 3,088 |
| "V. Unitis".. | 21.370 | 20.8 | 12—12 | 12 | 11 | 3,118 |
| "Jean Bart". | 23.470 | 21.7 | 12—12 | 10 | 10¾ | 3,780 |

Moreover, the "Kaiser," being laid down in 1909, is by no means the latest German battleship. Also, the "Jean Bart" carries 12-inch guns, and not 13½-inch, as stated in your war issue of September 5th, 1914.

From the above it will not be difficult to see that the fighting value of these ships is in the order named, with the "Kaiser" running a close second to the "Iron Duke." With her *complete* belt of 14 inches, no doubt quite a few would bet on the "Kaiser" to be the best ship in the lot, also on account of her superior speed.

San Francisco, Cal. CHARLES VORNHOLT.

## Long-range Guns in Forts

To the Editor of the SCIENTIFIC AMERICAN:

In your issue of December 26th, 1914, there appeared an article by Adrian Getaz, "Some Suggestions About the War."

He believes that if a fortress should have larger and longer ranged guns than its attacker that fortress would not fall. This would be so if every bit of ground within range was visible to the garrison of the fortress. But with ranges of ten and fifteen miles this is no longer possible.

The lighter movable guns are moved by night to invisible positions. The exact location of the fortress and most of the details are known through spies before the war began. The fall of the shots is observed, while the fortress strikes blindly.

If the fortress is surrounded by a friendly army strong enough to hold or win all points of observation within range, then the long-range fortress guns can give that army great support if it is attacked. If that army is driven away or driven into the fortress and is unable to make sorties, that fortress will fall, no matter how many long-range guns it may have, if it is attacked by modern, efficient, heavy artillery.

New York city. F. A. DE PEYSTER.

## Suggestions for a Reserve Army

To the Editor of the SCIENTIFIC AMERICAN:

Your articles on the defenselessness of the United States and our inadequate army touches on a theme dear to my heart, and tempts me to offer a suggestion, as the subject of an article for your able pen.

It is only of recent date that army regulations have made it possible for the United States to build up a reserve force from the ranks of discharged soldiers; but unfortunately this reserve cannot be formed until the men now serving enlistments are discharged.

There are many thousands of ex-soldiers in the various parts of the country over whom the Government has lost its jurisdiction, but who would be a valuable addition to our standing army. It is true they cannot be compelled to act as reserves, yet there are many among them who would voluntarily place themselves on the reserve list, if the Government prepared one and made the appeal.

Many of these men, if not all, are proud of their service; and would gladly be still connected with the service; but object to being compelled to follow another period of routine, such as militia service, etc.

There are those who will say it is superfluous, that these men would be available in war time anyway; quite so, but they would be widely scattered among the untrained volunteers, and it would be impossible to separate the chaff from the wheat. On the other hand, with these trained ex-soldiers on a reserve list, they could be immediately mustered into a separate body, and be available as trained troops, where otherwise they would be lost among the raw levies.

How could these men be kept track of? And of what would their obligation consist?

An applicant may have served at least one year in the regular army, or three years in the militia, be under thirty-five years of age when enrolling; take the same oath as administered in regular enlistments and be bound thereby; and to keep informed the department under whose jurisdiction he is placed of changes in address; or in the event of leaving one district obtain a transfer to another. Reservists should be compelled to attend maneuvers for one week each year, being supplied with a uniform by the Government at the time of enrolling.

The yearly attendance at maneuvers to be the only requirement of the reserves, it would be looked upon as a vacation rather than a duty. They to be called to the colors only in case of war.

There may be other policies suggested, but I think none could be brought into effect quicker, or with less expense, if the Government could be induced to make the experiment.

I trust you may be able to use this theme as a means of radiating enthusiasm into the powers that be through an article in your columns.

Chicago, Ill. V. H. BIELEFELD.

## Who Invented the Periscope?

To the Editor of the SCIENTIFIC AMERICAN:

It is stated by some writers that the periscope, the eye of the submarine, was invented by the French. The first device of this kind to be used in naval warfare was invented by Thomas Doughty in 1864. He was at that time acting chief engineer in the U. S. Navy. During Banks's Red River expedition Doughty was on the turreted monitor "Osage." The gunboats were annoyed by bushwhackers and Confederate cavalry picking off their men. Doughty rigged up a sheet iron tube extending from a few feet above the deck to the engine room below, with openings near the top and bottom, and by arrangement of mirrors he could see on shore. When attacked, he would signal the gunners to turn loose, and the enemy soon learned to give the "Osage" a wide berth. He little realized that his invention would be utilized in the world's greatest war. On the "Indianola" Doughty ran the batteries at Vicksburg, and his vessel was sunk in the fight near Grand Gulf and he was captured. After his exchange he was assigned to the "Osage," which was blockading the mouth of the Red River. While on this duty he took twenty men and captured two large Confederate transports, for which he was complimented by Admiral Porter. He distinguished himself in the Red River expedition and subsequently at Mobile. He was one of the old-time, resourceful engineers of the Mississippi River, and after the war he resumed his profession. He died in St. Louis in 1896. W. R. HODGES.

St. Louis, Mo.

## Disabling a Locomotive

To the Editor of the SCIENTIFIC AMERICAN:

The paragraph on page 519 of the issue of Dec. 26th, 1914, regarding the best way of disabling a steam automobile, brings to the writer's mind the rather elegant way of putting a locomotive quickly and permanently out of commission, used in the civil war. The steam chest covers were removed and the bridges between the ports in the slide valve seats were smashed out, and the covers carefully replaced, so that from all appearances nothing had been tampered with. The enemy, after firing up, was pleasantly surprised when all the steam chose to go directly up the stack and not pay a visit to the cylinders *en route*.

The writer has seen a number of war pictures showing the efforts of the retreating Belgians to wreck the railroad lines. In each case the ballast had been removed from under the track, leaving the ties and rails intact. With a few jacks and a gang of shovelers the line could be brought up to a fair grade about as quickly as it had been wrecked. Sherman's "bummers" did a more thorough job by tearing up the rails, heating them white hot in fires built of the ties, and wrapping them artistically around the neighboring telegraph poles and tree trunks. HERBERT FREEMAN.

Newark, N. J.

## Congress and Our Military Defenselessness

To the Editor of the SCIENTIFIC AMERICAN:

Why, in view of the disinterested stupidity of our present Washington representatives, would it not be possible to form what might be called a "National Defense Society"—taxing each member a possible and extreme yearly charge of $5, and providing a suitable badge if thought desirable?

The understanding being that the money thus derived be used for defense purposes under a competent board.

From $50,000,000 to $100,000,000 could be raised.

A reasonable yearly wage might be paid to a "Citizen Militia," providing rifles, ammunition, air-craft, etc.

I cannot express my indignation at the want of common sense being shown in Washington, and I believe if your valuable publication were to present some such proposition, you would be agreeably surprised at its instant popularity.

The average true citizen of the United States is most patriotic, and I have thus far failed to talk with any one who is not disgusted at the ignorance and apathy being shown by those whose duty it certainly is to see that we are properly protected.

As conditions now are we are humiliated by our weakness.

Through the incompetence of our present Administration, the citizens of the United States are being taxed and doubly taxed with a certain prospect of a deficit of some $40,000,000, yet our most respected and highly educated President is pressing an additional expense of $30,000,000 for an unlawful purpose, which not only renders us liable to serious and almost certain international complications, but increases the deficit, and which the people of this country must pay whether they will or not.

If you will give this matter your serious attention, although I am fully aware of the crudeness of my suggestion, you will greatly oblige a subscriber of long standing. BOSTON.

P. S.—The writer has lived abroad a number of years, and has a more than ordinary knowledge of naval matters, and he finds your War Issues as published to date wonderfully instructive.

[There is at present a National Security League, with headquarters at 25 Pine Street, New York, which is engaged in laying the facts as to our military defenselessness before the country and making Congressmen pay heed to its naval and military advisers.—EDITOR.]

## How Lieut. Gerstner Perished

To the Editor of the SCIENTIFIC AMERICAN:

I beg to invite your attention to the paragraph headed "Army Aviator Perishes," page 79, your volume cxii, No. 4, of January 23rd, 1915. Lieut. Gerstner was uninjured upon reaching the water, as was the machine practically.

Capt. Muller, in his testimony before the Board of Officers which investigated the accident, stated in part as follows:

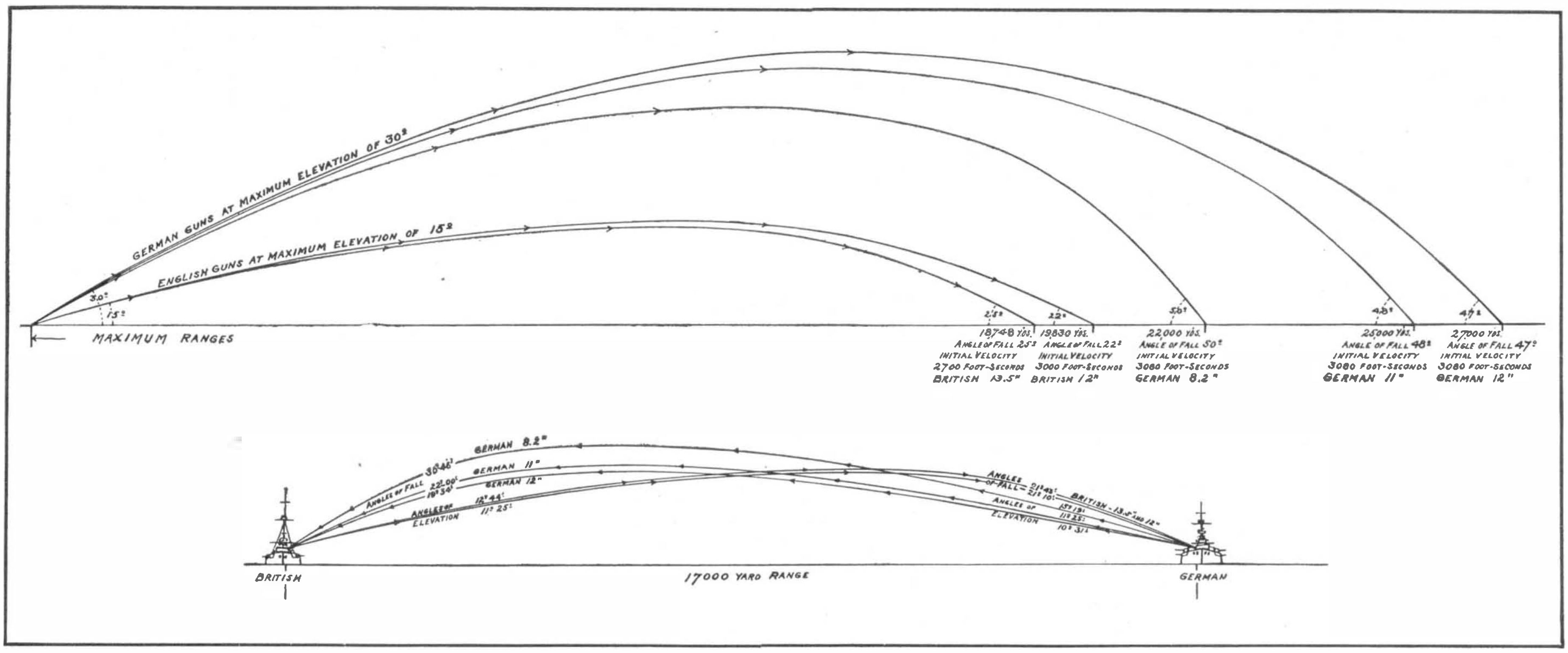
"She was then coming almost vertically downward, sliding to the left. I seemed to pull her up slightly, and when about 300 feet from the water, unable to handle my power in any way, I cut the switch. I felt full control of the machine when about 50 to 100 feet over the water. I made a normal landing on the water, but could not head into shore, as I had to use all my speed trying to slide the ship sidewise into the wind. The ship landed undamaged except for a few wires in the wing section which were streaming in the wind. The machine as it came to a stop went down by the nose. Lieut. Gerstner was under water. I pulled him up to the rear seat and we got out, standing on the running gear. I couldn't distinguish any bottom. We examined the shore line. Only two houses were in sight. No signs of life were visible. We examined the machine, trying to remove some parts that would float us in, especially the flaps. Required tools. Endeavored to secure the tool kit. It was under water about four feet. I dived for it several times, located it, but it was wired so tightly that I could not release it. Gerstner and I then helped each other undress. I don't recall whether he took off his flannel shirt or not, as I advised him to keep some wool on his body. I had a wool union suit on. We examined the machine very carefully by swimming around it during this time and found all controls intact—surfaces, hinges, and wires. We then discussed plans for getting relief. Gerstner favored swimming ashore. We were about a half mile out when we landed. I favored sticking to the ship until it was reasonably certain that no boat would put out from shore. Gerstner insisted that one of us ought to go ashore, and I offered either to go myself or to draw lots with him. I told him that I didn't believe either one of us could make it. He claimed that he was an experienced swimmer; that many times he had swum two or three miles. I had no knowledge of his ability to swim, and thought he was trying to encourage me. I accordingly had no faith in his ability to swim, and remonstrated for a long time with him. After we had been in the water what seemed a long time, Lieut. Gerstner said he was going ashore, and he asked me what I wanted him to do when he got there. I said, 'If you are going ashore, you had better notify San Diego and Los Angeles to get out fast motorboats and, if possible, save us, because I don't think the machine will float an hour longer at the most.' Gerstner left, but when he was about forty or fifty feet out I felt it was impossible and called him back, telling him so. I had a cramp at that time, and I asked him how he felt. He said he felt good enough to make the shore if he went then, before we got any farther out to sea. Shortly after, he started the second time and got about a half mile when he disappeared, and then shortly after that the ship was going pretty low and I started to swim myself, but when I got out a short distance I realized that I couldn't make it and put back. Then I tied myself to the elevator wires and waited. Finally a boat picked me up."

It is to be observed that the lamentable death of Lieut. Gerstner was caused by the attempt to swim ashore and might have been due to any accident of the sea. Such a paragraph as that in your issue of January 23rd has a tendency to create a wrong impression in the minds of the public and has an injurious reflex on the aviation service of the Army.

GEORGE P. SCRIVEN,
Brigadier General, Chief Signal Officer of the Army.
Washington, D. C.

# Hitting an Invisible Ship at a Ten-mile Range

## How the Greater Elevation of the Lighter German Guns Enables Them to Outrange the Enemy




**Data for maximum possible elevation, 30-degree German, 15-degree English.**

| BRITISH 13.5″ GUN. Fifteen Degrees. | BRITISH 12″ GUN. Fifteen Degrees. | GERMAN 12″ GUN. Thirty Degrees. | GERMAN 11″ GUN. Thirty Degrees. | GERMAN 8.2″ GUN. Thirty Degrees. |
|---|---|---|---|---|
| Initial velocity, 2,700 f.s. | Initial velocity, 3,000 f.s. | Initial velocity, 3,080 f.s. | Initial velocity, 3,080 f.s. | Initial velocity, 3,080 f.s. |
| Weight of projectile, 1,250 lb. | Weight of projectile, 850 lb. | Weight of projectile, 860 lb. | Weight of projectile, 660 lb. | Weight of projectile, 275 lb. |
| Angle of elevation, 15°. | Angle of elevation, 15°. | Angle of elevation, 30°. | Angle of elevation, 30°. | Angle of elevation, 30°. |
| Range, 18,748 yds. | Range, 19,830 yds. | Range, 27,500 yds. | Range, 25,900 yds. | Range, 22,000 yds. |
| Angle of fall, 25°. | Angle of fall, 22°. | Angle of fall, 47°. | Angle of fall, 48°. | Angle of fall, 50°. |

**Data for 17,000-yard range.**

| BRITISH 13.5″ GUN. | BRITISH 12″ GUN. | GERMAN 12″ GUN. | GERMAN 11″ GUN. | GERMAN 8.2″ GUN. |
|---|---|---|---|---|
| Initial velocity, 2,700 f.s. | Initial velocity, 3,000 f.s. | Initial velocity, 3,080 f.s. | Initial velocity, 3,080 f.s. | Initial velocity, 3,080 f.s. |
| Weight of projectile, 1,250 lb. | Weight of projectile, 850 lb. | Weight of projectile, 860 lb. | Weight of projectile, 660 lb. | Weight of projectile, 275 lb. |
| Range, 17,000 yds. | Range, 17,000 yds. | Range, 17,000 yds. | Range, 17,000 yds. | Range, 17,000 yds. |
| Angle of elevation, 12° 44′. | Angle of elevation, 11° 25′. | Angle of elevation, 10° 31′. | Angle of elevation, 11° 25′. | Angle of elevation, 15° 19′. |
| Angle of fall, 21° 43′. | Angle of fall, 21° 10′. | Angle of fall, 19° 34′. | Angle of fall, 22°. | Angle of fall, 30° 46′. |
| Striking energy, 12,806 ft. tons. | Striking energy, 8,353 ft. tons. | Striking energy, 8,890 ft. tons. | Striking energy, 6,196 ft. tons. | Striking energy, 2,115 ft. tons. |

ONE of the surprises of the present naval war is the extraordinary ranges at which the engagements between ships carrying armor-piercing guns are being fought. In the action between Von Spee and Cradock off the coast of Chile, the first 8.2-inch salvos of the "Scharnhorst" and "Gneisenau" landed on the "Good Hope" with telling effect at 12,000 yards. In the engagement off the Falkland Islands, the earlier stages of the running fight were fought at 15,000 yards range. Later in the battle-cruiser engagement in the North Sea, Admiral Beatty in his official dispatch stated that he began to land on the enemy at 17,000 yards, or say ten miles; and later descriptions of the fight by those engaged stated that the range never fell below seven miles.

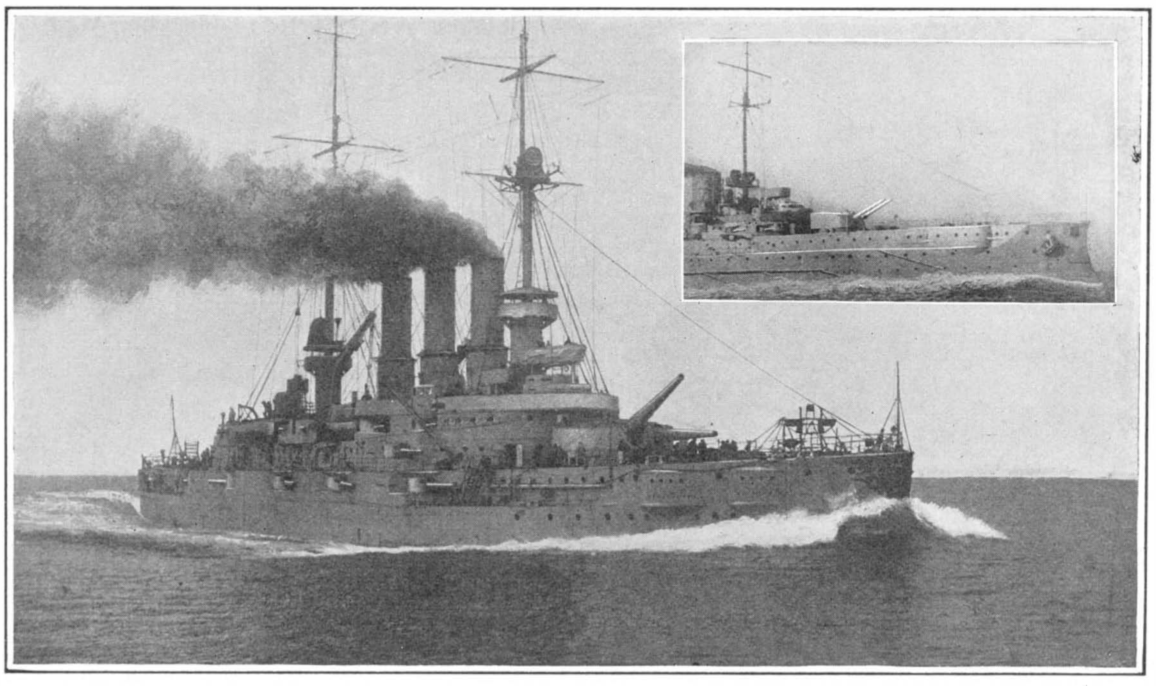
The question has been raised as to whether the lighter German guns were able to reach the British battle-cruisers during the earlier stages of the fight when the 13.5-inch shells were getting home. This is a decidedly interesting point, and with a view to presenting the actual conditions, we publish the accompanying photographs and diagrams, which show that not only the 12- and 11-inch, but also the 8.2-inch guns of the German battle-cruisers and armored cruiser were able not only to reach, but to outrange the British ships, and also that their penetrative power was theoretically sufficient for them to have done deadly execution.

It should be explained that the data regarding these guns, both British and German, are taken from the published commercial tables of Vickers-Maxim, Armstrong, and Krupp. With the exception of the British 13.5-inch guns, whose initial velocity is 2,700 feet per second, the velocities given are very high for guns of large caliber. They are perfectly possible; but because of the intense heat of combustion of the large powder charges necessary to secure these velocities, the erosion is presumably very high, and the accuracy-life of such guns is limited. The Krupp people claim to have mastered the problem of erosion; but whether by use of a special steel for the inner tube or by the quality of their powder, or both, they do not state. We do know that one of the leading naval powers not long ago made an offer to give the Krupp firm a contract to provide all of their heavy guns, provided a guarantee was given that, using these high velocities, the guns would have an accuracy-life of 250 rounds. The offer was refused. As regards the British guns of Vickers-Maxim and Armstrong, it is known that erosion is severe; but the British claim that they can reline their eroded guns so quickly, and at a cost so moderate, that they prefer to use high velocities, because of the great advantages of accuracy and hitting power at long ranges conferred thereby.

It will be noted from the diagrams that the British guns are credited with a maximum elevation of 15 degrees. That is the maximum for the main batteries in our own navy, and we believe the same practice is followed by the British. The motive for setting this limit is the fact that at 15 degrees elevation, when the ship is on an even keel, the shells will carry to a far greater distance than can be covered by the average sighting conditions on the high seas. The German Admiralty, however, with wise prevision, as it seems to us, have given to their heavy batteries a maximum elevation which is at least twice that of the British guns, namely, 30 degrees, or possibly more.

We present illustrations of two of their ships, the battleship "Schlesien," carrying 11-inch guns in its main battery, and the ill-fated "Bluecher," which mounted the 8.2-inch gun. In each photograph these pieces are shown swung up to full elevation, which apparently is slightly over 30 degrees. Now, referring to the diagram showing the trajectory of the shells at the 17,000 yards or ten-mile range at which the British first began to land on the Germans, we find that, if the velocities given are correct, the 8.2-inch guns of the "Bluecher," with an elevation of 15 degrees and 19 minutes, would have fallen on the British cruisers at an angle of 30 degrees and 46 minutes; that the 11-inch guns of the "Seydlitz" and "Moltke," firing at 11 degress 25 minutes elevation, landed their shells upon the British at an angle of 22 degrees, and that the 12-inch guns of the "Derfflinger," elevated to 10 degress and 31 minutes, would have hit the British ships at an angle of 19 degrees and 24 minutes. This last, it will be observed, is a flatter trajectory than that of the British 12-inch and 13.5-inch guns, the angle of fall of these being, respectively, 21 degrees 10 minutes and 21 degrees 43 minutes.

The diagram showing the curves of flight and the extreme ranges at the maximum possible elevation of the various guns, brings out the surprising fact that the 8.2-inch guns of the "Bluecher" were



**German battleship "Schlesien" and armored cruiser "Bluecher," showing high elevation of guns.**

capable of throwing their shells to an extreme range of 22,000 yards, or over 3,000 yards farther than the British 13.5-inch guns. The greatest range is that of the German 50-caliber 12-inch, which can throw its shell to a distance of 15½ miles; the German 11-inch can cover 14¾ miles; the German 8.2-inch, 12½ miles; the British 12-inch, 11½ miles; and the British 13.5-inch guns about 10 2/3 miles. It will be noted that the British 13.5-inch is outranged by the British 12-inch; which is to be accounted for by the fact that its initial velocity is 300 feet per second less.

The predisposing motive of the Germans in giving such high maximum elevation to their guns was to enable them to reach the enemy after their own ships, due to injury at the water line, had a heavy list toward the enemy. It is evident that the "Derfflinger," for instance, might be listed 15 degrees toward the enemy and still have 15 degrees of elevation available for long-range fighting. This wise provision has rendered it possible even for the lighter armor-piercing guns of the Germans to land upon the British at the great fighting ranges selected by the latter. It was the greater striking energy of the 13.5-inch gun and its much heavier bursting charge, coupled with better shooting and better engine-room equipment and operation, that enabled the British battle-cruisers to win the North Sea fight.

The striking energy of the projectiles at 10-mile range are: German 8-inch, 2,115-foot-tons; German 11-inch, 6,196 foot-tons; German 12-inch, 6,890 foot-tons, and British 12-inch, 8,353 foot-tons; British 13.5-inch, 12,806 foot-tons, or about 50 per cent more than that of the 12-inch gun.

When the British battle-cruisers began to land on the "Bluecher," her hull was invisible. Only by the fire control officers a hundred feet above the deck could her whole hull be seen. Similarly, when the 13.5-inch shells began to fall "out of the blue" upon the "Bluecher," the gunners in her turrets did not see the hull of the ship from which the projectiles came.

Among the many accounts given by participants in the North Sea fight, by far the most dramatic and instructive is that given by German survivors from the "Bluecher" and published in the *London Times* and *Sphere*, from which we take the following description:

"The British ships were away on the horizon, some 15 or 16 kilometers distant, when they started to fire. Shots came slowly at first. They fell ahead and over, raising vast columns of water; now they fell astern and short. The British guns were finding the range. Those deadly water spouts crept nearer and nearer. The men on deck watched them with a strange fascination. Soon one pitched close to the ship, and a vast watery pillar, a hundred meters high one of them affirmed, fell lashing on the deck. The range had been found. *Dann aber ging's los!* Now the shells came thick and fast with a horrible droning hum. At once they did terrible execution. The electric plant was soon destroyed, and the ship plunged in a darkness that could be felt. 'You could not see your hand before your nose,' said one. Down below decks there was horror and confusion, mingled with gasping shouts and moans as the shells plunged through the decks. It was only later, when the range shortened, that their trajectory flattened and they tore holes in the ship's sides and raked her decks. At first they came dropping from the sky." This observation is of particular interest; the diagram given on the adjoining page explains to what a great height the shells must have risen before they began falling toward the"Bluecher's" decks.

"The shells penetrated the decks," continues the *Times* narrator. "They bored their way even to the stokehold. The coal in the bunkers was set on fire. Since the bunkers were half empty the fire burned merrily. In the engine-room a shell licked up the oil and sprayed it around in flames of blue and green, scarring its victims and blazing where it fell. Men huddled together in dark compartments, but the shells sought them out and there Death had a rich harvest. The terrific air pressure resulting from explosion in a confined space left a deep impression on the minds of the men of the 'Bluecher.' The air, it would seem, roars through every opening and tears its way through every weak spot. All loose or insecure fittings are transformed into moving instruments of destruction. Open doors bang to—and jamb—and closed iron doors bend outward like tinplates, and through it all the bodies of men are whirled about like dead leaves in a winter blast, to be battered to death against the iron walls. In one of the engine-rooms—it was the room where the high-velocity engines for ventilation and forced draughts were at work—men were picked up by that terrible *Luftdruck* like the whirl-drift at a street corner and tossed to a horrible death amid the machinery. There were other horrors too fearful to recount.

"If it was appalling below deck it was more than appalling above. The 'Bluecher' was under the fire of so many ships. Even the little destroyers peppered her. 'It was one continuous explosion,' said a gunner. The ship heeled over as the broadsides struck her, then righted herself, rocking like a cradle. Gun crews were so destroyed that stokers had to be requisitioned to carry ammunition. Men lay flat for safety. The decks presented a tangled mass of scrap iron. In one casement, the only one, as they thought, undestroyed, two men continued to serve their gun. They fired it as the ship listed, adapting the elevation to the new situation. The 'Bluecher' had run her course. She was lagging lame, and with the steering gear gone was beginning slowly to circle. It was seen that she was doomed. The wounded 'Bluecher' finally settled down, turned wearily over, and disappeared in a swirl of water."

## The Present Geographical Position of Serbia

By J. Cvijic

*Serbia—the country which we of English speech so long miscalled "Servia," to the great annoyance of its inhabitants—has suddenly become an object of interest to the whole world, on account of the casus belli which it has furnished to the great Powers of Europe. Hence it seems timely to present the following abstract of a paper which appeared just before the outbreak of the present war in the recently founded Bulletin of the Serbian Geographical Society, as giving some idea of what the Serbs themselves think of the position of their country in contemporary geography.*—EDITOR.

AFTER Montenegro, Serbia was the first Balkan state to emancipate itself from Turkish rule. In its original form, 1815-1833, it had an area of 7,790 square miles. Since that time it has spread mainly in a southerly direction. In 1833, enlarged by Prince Milosh, it attained an area of 14,570 square miles, and in 1878, after the Congress of Berlin, its surface amounted to 18,650 square miles. Since the treaty of Bucharest, 1913, the area is about 33,900 square miles. Along with these alterations in size, there has been a considerable modification of its original geographic position. It has gradually ceased to be a sort of outlying dependency of the great Pannonian basin and of the Austro-Hungarian monarchy, and has pushed its way south toward the center of the Balkan peninsula, along the axis indicated by the great valley of the Morava. At the same time, to a more and more marked extent, there have been added to the Dinaric Serbs, who constituted essentially the Serbia of Karageorge, the Serbs of the southern Morava and of the Vardar.

The territorial extension which followed the wars of 1876-78 definitely determined the development of Serbia toward the south. The country now not only included nearly the whole southern basin of the Morava and commanded the entrance to the Balkans, but also contained the focus of the two great highways intersecting the peninsula, viz., Nish, at the bifurcation of the road to Constantinople and that to Salonika. It had entered a new ethnic zone, in its spread toward Pirot and the southern Morava. This southerly movement had been forecast in the popular songs of the country, in which recurred the names of Kossovo, Prizren, Skoplie, Prilep, etc., and was stimulated by unhappy political and economic experiences in the north.

Serbia now occupies a truly central position in the Balkan peninsula, extending from the Danube to the vicinity of Salonika. To the Serbia of the Morava has been added the Serbia of the Vardar. The country possesses, through nearly its whole extent, the great central artery of the peninsula. Belgrade, Nish, Skoplie, and Salonika, which mark out this great natural route, are now about to assume the importance to which they are entitled. Moreover, Serbia now holds what may be termed the heart of the Balkans, viz., the region lying between Nish and Veles, and especially that including Skoplie and the Ovchepolye. In this region meet and intersect, or are destined to do so, all the great highways of the peninsula. Finally, the barrier between Serbia and Montenegro formerly presented by the sanjak of Novibazar has now disappeared; Bosnia is henceforth cut off from Salonika; while Serbia is now able to gain direct access to the sea by way of Montenegro.

When we consider the progress of the civilizing influences at work in Serbia we find that the Serbs, and especially the Dinaric Serbs, readily respond to such influences, but at the same time have the faculty of adapting new ideas to suit the national character. Serbia, unlike the countries constituting the other two Mediterranean peninsulas, is united to Europe by a great plain. Moreover, the shortest route from Europe to the rest of the Balkan peninsula, the Aegean, and Asia Minor passes through her territory. Again, the spread of the Serbian race beyond the frontier toward the north, and west to the Adriatic, tends to attach Serbia more intimately to Europe than any other Balkan state. Nevertheless Serbia is by no means so strongly dominated by the influence of her northern neighbors as these facts might lead one to suppose. More and more, in her intercourse with the rest of Europe, she tends to pass right over the vast Pannonian basin, the immense Hungarian *puszta*, in which dwell people who have remained strangers to her in language, mentality and institutions. By a curious geographic anomaly, not only is this great fertile plain devoid of any marked influence upon the rugged country which borders it to the south, but it actually plays the role of isolating the latter more effectively than a chain of mountains might do. Only two routes, Belgrade-Budapest and Belgrade-Fiume, put Serbia in communication with the countries beyond.

During a recent period, lower Austria and Bohemia were the regions which gave most to Serbia, especially in supplying the material needs of existence. In recent years this intercourse has very sensibly diminished. Ideas, policies, and institutions have come under the influence of western Europe. With the exception of medical students, who are still educated mainly at the Austrian universities, nearly the whole youth of Serbia obtains its higher education in more distant countries—France, Germany, Switzerland and Belgium.

Since 1913, Serbia, previously subject almost exclusively to European influences, has pushed southward into the regions of old Balkan culture—i. e., Byzantine civilization as modified by Turkey—a type of culture from which, however, Moravan Serbia had not yet had time to become completely divested since its liberation from the Turkish yoke. This finds expression, for example, in markets of wooden booths, crooked and narrow streets, cross-legged merchants selling a little of everything; household furniture, cuisine and costumes very different from those of Europe; marked contrasts between the civilization of the towns and the patriarchal life of the country, etc. Moreover, in the south Serbia has entered a zone of climates and products which are new to her.

The old Balkan culture seems destined to disappear from the Serbia of the Vardar basin as it has disappeared from Moravan Serbia, since its existence appears to be dependent upon the rule of the Turk. It will, nevertheless, leave enduring traces.

Along an extensive frontier Serbia now finds herself in contact with modern Greece. In this contact the Greek temperament will probably exercise a greater influence than the Greek culture. This is characterized by alertness, a strong commercial spirit, and intense national pride. She will also feel the influence of Salonika and the distinct type of culture of which that place is the center. Lastly, she will come more fully than in the past under various Mediterranean and Levantine influences.

On the east her contact with Bulgaria will continue to play a neutral role, as to effects on her culture; while her new frontier with Albania will exercise a somewhat unfavorable influence in this respect.

## Berlin Higher Schools and the War

THE higher educational institutions of Berlin have been greatly affected by the war, says the Berlin *Lokal Anzeiger*. Of the 7,059 men and 976 women who are enrolled as students in the university 4,269 men and 75 women are on leave of absence for army and hospital service, and it is probable that many others have gone to the front without notifying the university authorities. Among the 238 foreign students of the university are 22 Russians and 1 Englishman. In the Charlottenburg Technical School, which had 2,634 students last summer, only 684 were enrolled for the winter semester, and so many of these have since been called to the colors that the actual attendance is probably less than 200.

The Academy of Music, which had 331 students last summer, now has only 203, of whom 20 are foreigners. The Academy of Fine Arts, which usually has 300 students in winter, now has only 100.

The Veterinary College, which last summer was attended by 140 pupils of the Military Veterinary Academy and by 333 other students, now has a total attendance of 108 students, most of whom are too young for military service. The attendance at the Agriculture College has fallen from 897 to 169.

The Royal Academy of Mines still has the names of 180 students on its lists, but 140 of these are "on leave," i. e., in the field. Finally, the High School of Commerce, which had 562 students, even in the summer, now has only 372 enrolled, and only 167 in actual attendance.

## Protection from Frost

IT is safe to say that much more attention has been paid to the problem of protecting plants and trees from frost in the United States than in all other countries combined. The problem is far from complete solution, however, and hence there was ample room for the collection of memoirs on the subject which constitute almost the entire contents of the *Monthly Weather Review* for October, 1914 (published in February, 1915, by the Weather Bureau at Washington). This symposium begins with a summary review of the subject, from a physical point of view, by Dr. W. J. Humphreys, which is followed by contributions from Weather Bureau officials and others, dealing with the question practically, historically, and controversially.

# Getting the Range

## Instruments Which Make Gun Fire Effective at Distances Up to Ten Miles

CLOSE one eye, and then bring the tip of the index finger down upon any small object within reach and at about the level of the open eye. A man who has never tried this experiment will be astonished to find that his finger may overreach or fall short of the object by as much as an inch or more, and yet using both eyes, he could act with such accuracy as to bring two pin-heads together at the very first attempt. This shows how much we depend upon triangulation for the judging of relative distances. With a camera one may gage distances up to one hundred feet or so by carefully noting the length of focus necessary to produce a sharp image on the ground glass. Similarly with the naked eye, we may estimate short distances by the change of focus in the eye itself; but for greater distances we have to utilize the principles of triangulation employed in range-finding.

In a loose sense of the term we are all "cross-eyed" most of the time. In order to see an object, the eyes must converge or turn in so that the optical axes will cross upon it. The nearer the object, the more they turn in. It is only when "day-dreaming," or looking at an object an infinite distance away, that the optical axes are strictly parallel.

Harking back to our school days, we recall that the triangle is a figure with which much mathematical juggling may be done. It possesses three sides and three angles, and if any one side and any two of the other five elements be known, the whole triangle, no matter what its shape, can be reconstructed, and the size of every angle and side be determined. Whenever we look at an object we solve unconsciously a problem in trigonometry. A triangle is formed, with the eyes at two corners and the object at the third. The base of the triangle is the distance between the eyes, and the convergence of the eyes gives us two angles at each end of the base. No one bothers to find out the length of this base line or the value in degrees of the two angles, but by long practice everyone has acquired an ability to gage the triangle by unconsciously testing the muscular strength required to train the eyes upon the object. While few of us have learned how to gage actual distances, we can all sense the relative size of triangles with such precision that, for objects within a short range, we can tell to a sixty-fourth of an inch whether one object is nearer to us than another; because in looking from one object to the other there is an infinitesimal contraction of the angle of convergence. The actual change in this angle is measurable in seconds of arc, and yet we can feel and gage the slight tug of the muscles necessary to swing the eyes through this minute angle.

The reason the change of angle is so small is because the distance between the eyes is but one fifth of a foot. But what if we had a broader eye-base? If our eyes were set apart as far as an elephant's, how much more distinctly would distant objects stand out in relief? What if we used some artificial means of virtually spreading them apart a dozen feet or more? That is what the modern range-finder does, and it is also equipped with means for measuring the convergence necessary to train the gaze upon a distant target. With a base of fixed length and the measure of the two angles at the ends of the base known, it is then a simple matter to reconstruct the triangle formed between the range-finder and the object and to determine the distance of the object from the range-finder.

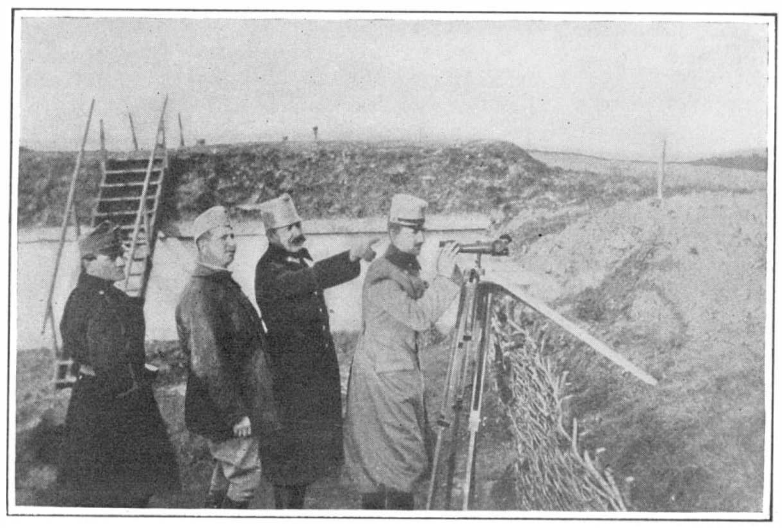
Fig. 1 shows a typical range-finder which will be seen to consist of two telescopes with a single eye-piece. In the illustration the eye-piece is shown at $A$, and it will be seen that the telescopes run at right angles to the eye-piece in opposite directions, one of the objectives being indicated at $B$ and the other at $B^1$, while the two crossed prisms $C$ and $C^1$ turn the rays that enter the objective into the ocular $A$. At the ends of the range-finder tube are two pentagonal prisms, $D$ and $D^1$, which divert the rays entering the apertures of the range-finder, and send them at right angles into the objectives. Thus, an observer at $A$ will see two images, one above the other, the upper image being that which he sees through the right-hand end of the range-finder, and the lower image that which comes in at the left-hand end. The view will be something like that shown in Fig. 2, in which the upper half of the field of vision is out of register with the lower half. In order to bring the two images into coincidence, circular glass wedges $E$ and $E^1$ are placed before the prisms $D$ and $D^1$. By operating a thumb screw which is not shown in Fig. 1, because it lies above the plane of the section, the two circular wedges are simultaneously rotated, bending the rays that enter the range-finder until the two images seen in the ocular are brought into coincidence. A micrometer device measures the amount of rotation necessary to produce this result. But, instead of giving the measurement in degrees, it is calibrated to give the linear distance of the target from the range-finder. The calibration may be seen through the second eye-piece $F$, which, by means of a pair of prisms, is brought to bear upon the micrometer scale.

Of course, the longer the base line of the instrument the more efficient it is. Range-finders used on ships may use a base line a dozen or more feet in length, but for field service this would be entirely too bulky. The ordinary portable range-finder has a base between three and four feet long. In the case of fixed artillery in forts, ranges are found by placing observers a mile or more apart and connecting them by telephone or telegraph in such a way that they may make simultaneous observations from each end of this long base line and report to a common chart room where angles are worked out and the position of the target determined with a wonderful degree of accuracy.

Range-finding has been reduced to such a science that it is necessary to conceal batteries or guns. The battery must be kept out of sight, and it must fire at an enemy which also remains out of sight. The man who directs the firing may be at a great distance from his battery, located at some point of vantage, where he may obtain the range and signal it to his gunner. Knowing that at any moment he may become the target of the enemy's fire, and realizing the accuracy of modern artillery, it is very necessary for him also to remain concealed. Some of the methods of concealment are shown in the accompanying photographs. A system similar to that of the submarine periscope is employed in the German army, so that a man hidden behind a natural breastwork may raise his artificial eyes far above him. Even the top of the periscope is frequently disguised by wisps of straw, so that it is next to impossible for the enemy, at the enormous range of modern fighting, to discover his whereabouts.

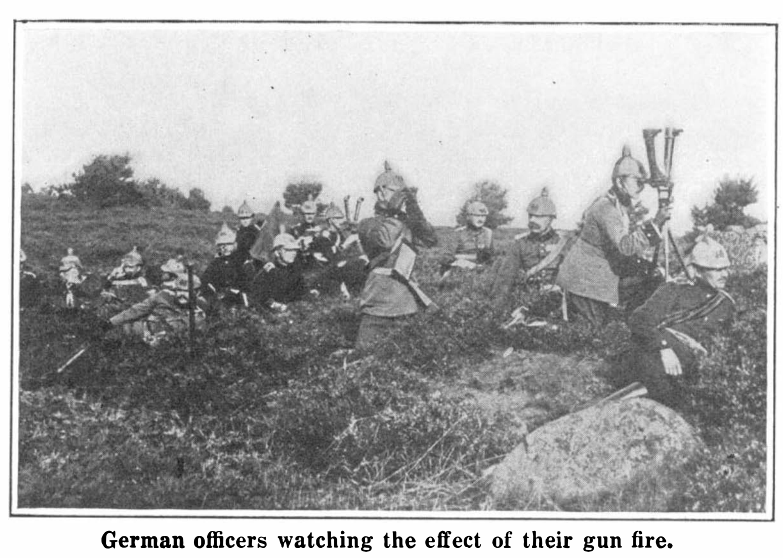
Not only is it necessary to foretell the range, but the observer must confirm his estimate by watching the actual effect of the fire of his guns. He may find that he has underestimated the distance of the target and must signal to have the guns elevated accordingly. For such purposes a range-finder is not required, but field glasses may be used; these, also, are arranged like the periscope of a submarine to protect the observer.

**The periscope raises the eyes far above the surrounding country.**



**A field telemeter or range-finder as used by officers of the Austrian army to study the positions of the Russian forces.**

The observers, concealed behind breastworks, are endeavoring to locate and determine the range of the hidden batteries of the enemy in order to direct the fire of their own guns.

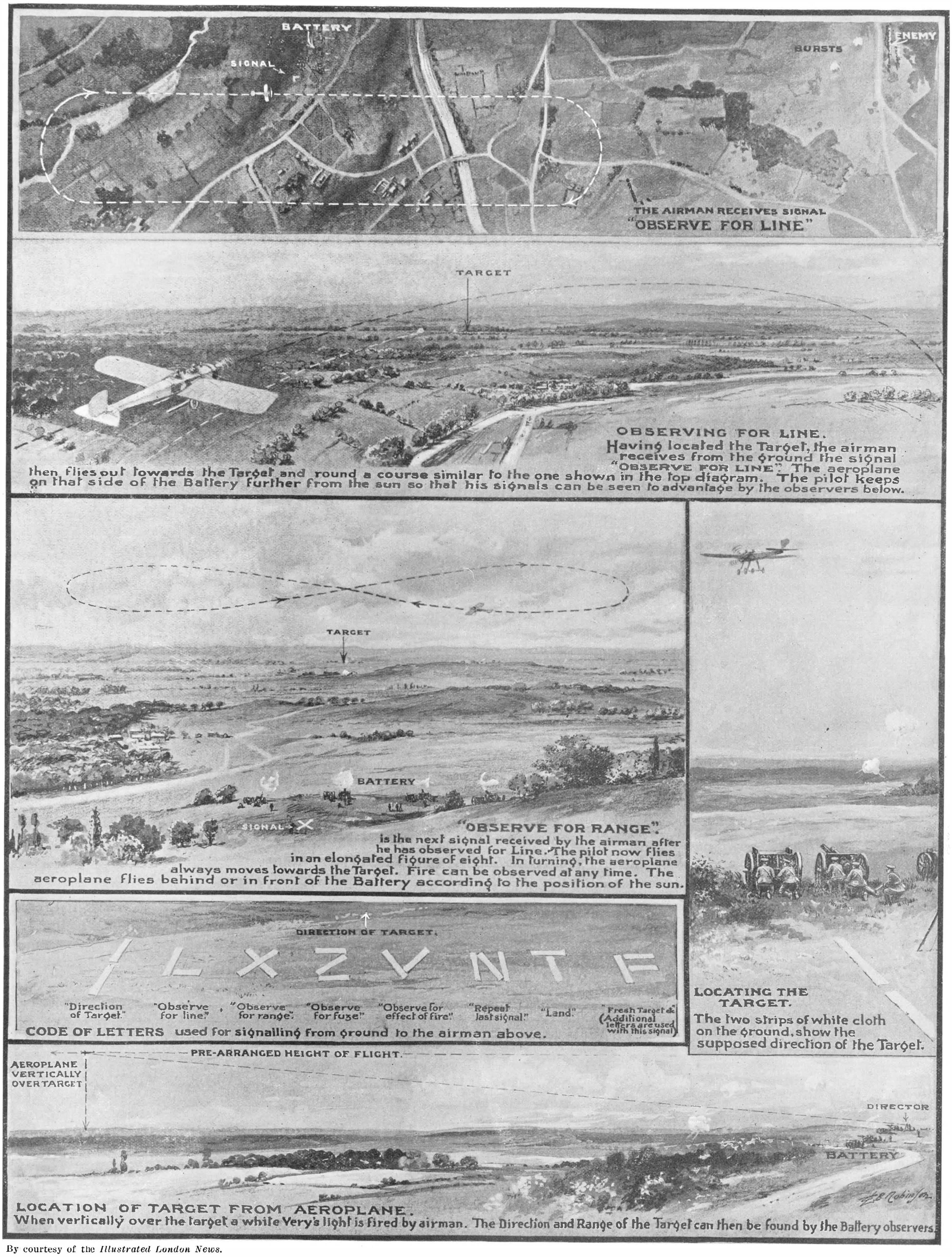


**German officers watching the effect of their gun fire.**

INSTRUMENTS FOR GETTING THE RANGE

In the present war the aeroplane has proved invaluable for locating the enemy and directing the fire of artillery. Herewith is a series of pictures illustrating how the man in the sky locates and signals the range to the man behind the gun. The aviator rises to a prearranged height and, maintaining that altitude, flies in the supposed direction of the enemy. As a guide, strips of white cloth are laid on the ground. Such a guide is shown in one of the illustrations, but it will be understood that this, as well as the code letters, are merely typical signals, and do not represent any actually in use. After the airman has located the target, he sails right over it and signals by dropping a Very's light, using one or a number grouped in some prearranged combination. Two observers near the guns with instruments between them check the distances automatically, which they can do with considerable accuracy since the aeroplane's height above the ground is known. The firing can then begin. The direction or line of firing is checked by the airman, who steers in an elongated oval between the batteries and the enemy, signaling with Very's lights. Similarly he reports how the shells are bursting, whether short or beyond the target, or whether they are landing true.

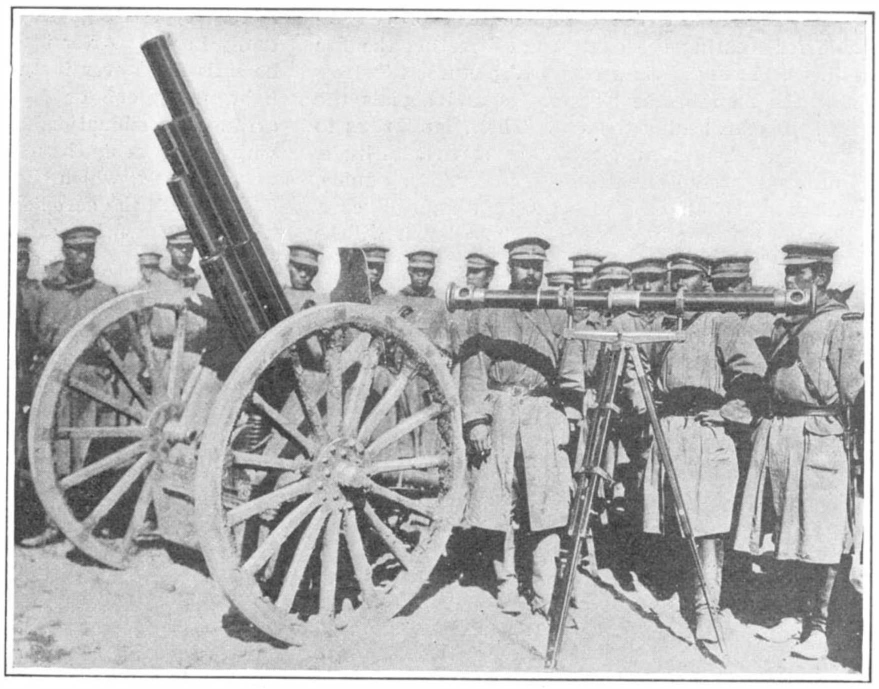
The range-finder we have shown in Fig. 1 is merely typical of the kind usually employed. There are a great many modifications of it; too many to describe here. In some the upper half of image field is inverted, as shown in Fig. 3. This is claimed to give a better guide to perfect alignment of the two images. In other range-




By courtesy of the *Illustrated London News.*

**Why the flying man is indispensable to the man behind the gun: how the target is found and the range is checked.**

**Periscope field glasses concealed by a wisp of straw.**



**Japanese using a range-finder at Tsingtau.**

finders prisms are avoided and mirrors are used instead, so as to overcome distortions due to variations of color. Yellow rays predominate if the air is saturated with moisture, red if the air is dry, and blue or blue-green on a dull, cloudy day, and so the range-finder will be found to err in overestimating or underrating the distances, according to the state of the weather. These, however, are refinements which only concern the man who has actually to use these instruments.

There are some range-finders based on entirely different principles from the one we have illustrated in Fig. 1. Figs. 4 and 5, for instance, show a range-finder which depends upon a knowledge of dimensions of the target. If, for instance, we know the height of the stack of a battleship above water, we may readily determine the distance of this target from us by measuring the height of the image produced in our field glass. Fig. 5 illustrates the principles of the device. Here we have two triangles meeting at the object glass *G* of the telescope, the line *H*, *I* being the known height of the target and *H'*, *I'* the height of its image in the telescope. The two triangles are similar, hence one is as much larger than the other as *H*, *I* is larger than *H'*, *I'*. The method of measuring *H'*, *I'* is shown in Fig. 4.

Attached to the eye-piece of the telescope is a device containing a pair of disk prisms or wedge-shaped plates of glass, which may be adjusted by means of a micrometer screw to elevate a part of the image. When, as in Fig. 4, the elevation is sufficient to bring the water-line of the part seen through the prisms to a level with the smokestack shown in the rest of the image field, the height of the image of the smokestack above the water is measured on the micrometer scale. But, instead of giving this height in fractions of an inch, the device may be set for a unit height, when the scale will give the actual distance of the object. In this case, for instance, the height of the smokestack may be 25 yards above the water, and the observer may know that for such a height each mark represents a hundred yards. As the observer found it necessary to turn the scale until 25 came opposite the marker, he knows at once that the battleship is 2,500 yards away.

It is seldom that one can depend upon an instrument of this sort, because the enemy may so readily change the dimensions of his ship and thus deceive the observer. However, this device may be used in conjunction with an ordinary range-finder, so that once the distance of the ship has been discovered, this simple instrument will show whether it is moving farther away or toward the observer and at what rate. For this reason it has been termed a "range-keeper."

Another range-finding device depends upon the known height of the observer above water level. This instrument, of course, can be used only on the sea, or in taking observations from the land on objects at sea. As is commonly known, the horizon lies always practically at the level of the eye, so that a line running from the eye to the horizon is practically a horizontal line. A truly horizontal line may be obtained by taking observations on the horizon fore and aft, at the same time, with a double telescope, and correcting the instrument accordingly. Now, if an observer is situated twenty-five yards above the sea and wishes to discover the range of an object between him and the horizontal plane, he may measure the angle through which he must depress the axis of one of his telescopes to train it upon the object, while the other remains fixed upon the apparent horizon. As is shown in the insert in Fig. 6, the apparent horizon or truly horizontal line is indicated by the line *KL* and *l* is the angle it makes with the object located at *M*. The observer knows his height above water level, which is *LN*, and drawing a line from *M* to *N*, we have a right-angled triangle *LMN*, in which the line *MN*, being also horizontal, is parallel to the line *KL*. Now, the angle *l* must equal the angle *m*, as our geometries taught us long ago, and we have, thus, a triangle in which one side *LM* and two angles *m* and *n* are known. With this knowledge we can easily estimate the length of the side *LM* or *MN* and determine the distance of the target *M* from the top or the bottom of the tower. The advantage of this system, of course, lies in the fact that it gives the observer a broad base line to work with, and thus enables him to determine the position of the target with greater accuracy.

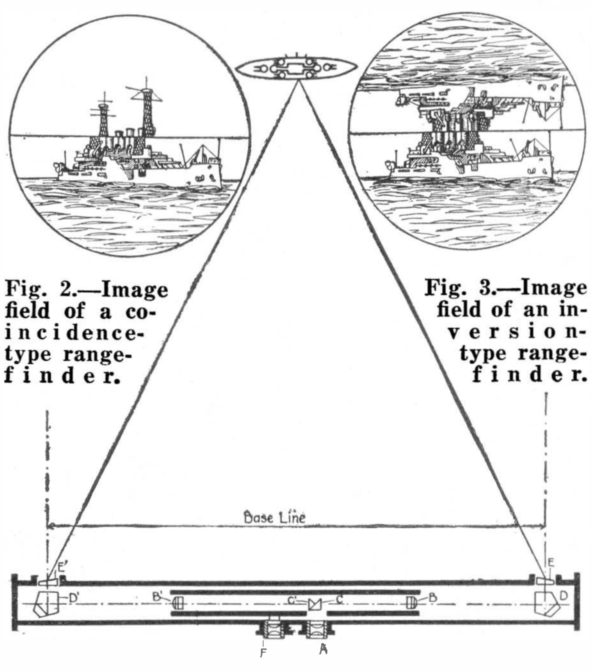



**Fig. 2.—Image field of a coincidence-type range-finder.**

**Fig. 3.—Image field of an inversion-type range-finder.**

**Fig. 1.—Diagrammatic view of a typical range-finder.**

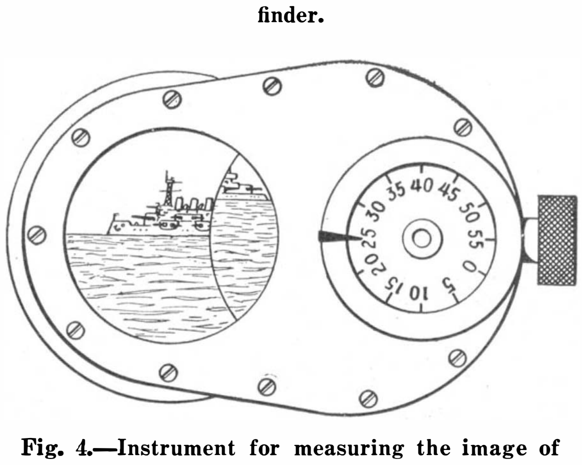


**Fig. 4.—Instrument for measuring the image of an object of known height.**

**Fig. 5.—Range finding based on similar triangles.**

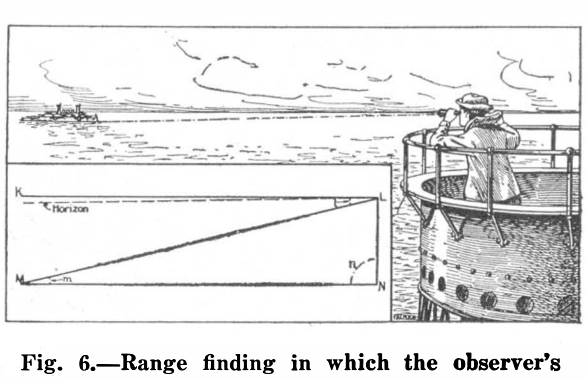



**Fig. 6.—Range finding in which the observer's height above the sea serves as a base line.**

## The Death of H. Ward Leonard

H. WARD LEONARD, electric engineer and inventor, once associated with Thomas A. Edison, died suddenly of apoplexy recently at the Hotel Astor.

Mr. Leonard was born in Cincinnati in 1861, and graduated from the Massachusetts Institute of Technology. The following year, at the age of 23, he became associated with Thomas A. Edison as a member of his staff of engineers to introduce his central station system. A few years later he was made superintendent of the Western Electric Light Company of Chicago, and a year later formed the firm of Leonard & Izard, which made many important installations of central stations and electric railways. In 1889 the firm was bought out by the Edison interests and Mr. Leonard became general manager of the combined Edison interests for the United States and Canada, with headquarters in this city.

In 1891 he completed his inventions of the Ward Leonard system of motor control, and in 1892 he gave the world his multiple voltage system, designed for operating motors and electric lights in factories. The value of the Ward Leonard system of control was demonstrated in battle during the Spanish-American war, where it was used on one turret of the "Brooklyn." After the war it was generally adopted by the United States Navy, and all of the ships were equipped with it with a few unimportant exceptions.

Another of Mr. Leonard's important inventions was the double-arm circuit breaker, which has come into almost universal use. Other important inventions are his lighting system for trains and automobiles and his form of change gear, which is now used in most high-grade motorcars. His system of motor control was applied to the moving side-walk at the Paris Exposition of 1900 after many ineffectual attempts to operate it by other systems, and was a feature of the exposition.

Mr. Leonard was a prolific inventor, having taken out over a hundred patents, including many connected with electric power, light and transportation systems. He was the founder of the H. Ward Leonard Manufacturing Company of Bronxville, N. Y.

## Farming in Siberia

WE have inherited from the traditions of the past the idea that Siberia is a country with a not very fruitful soil. Yet in the last few years very decided advances in farming have been made there, as a result of the efforts of the Russian government to arouse the native peasants and settlers to a more intensive cultivation of the ground. In the western section of the country, so the German journal *Prometheus* tells us, large associations of farmers have been organized for the export of their products. In 1912 butter to the value of 7,000,000 rubles (a ruble is about 51 cents) was exported. In 1913 this amount had doubled, for in this year butter to the value of 14,500,000 rubles was sold to Germany, Austria-Hungary, and England. In 1912 experiments were made in the manufacture of the English Cheddar cheese. After several failures the cheese, which is very popular in Great Britain, was so successfully imitated that in 1913 England imported 65 tons of Siberian Cheddar. The trade is carried on by ships directly from the interior of Siberia to London.

Rotary motors are used almost exclusively. They require so much care that they have not given satisfaction in the war. The principal advantage of the rotary motor—lightness—is largely neutralized on long journeys by the greater weight of fuel necessary as compared with the stationary type.

**How Germany Has Developed.**

German aircraft firms and pilots have received strong financial support since the inception of the industry. In the last two years a number of competitions have been held with very large prizes distributed in certain proportions to the winning pilots and makers of the successful aeroplanes and engines. Liberal prizes were also given for important isolated performances. Owing to this encouragement Germany possessed at the beginning of the war a very large and well trained aviation corps and a score of flourishing manufacturers producing machines to government approved specifications. The aeroplane fleet is remarkably homogeneous, many different marques having almost the same carrying capacity, speed and radius of action.

Most of the early German machines were absolute copies—sometimes authorized, more often not—of existing French types. In 1910 the Etrich Taube (dove) came into prominence, being manufactured by Rumpler to the designs of Igo Etrich, an Austrian engineer. The wing shape was derived from the Zanonia leaf, and Herr Etrich had been building monoplanes on this principle since 1907. As this machine is typical of a large class of monoplanes a short description may be given.

The wings have back-swept upturned tips flexed up and down for the maintenance of lateral stability. Instead of the usual system of lower bracing cables, a biplane type of bracing is secured by means of a boom running some distance out from the fuselage below and parallel with the plane to which it is connected by short struts diagonally cross-wired. The outermost strut is continued upward above the plane, forming a king post to which the cables keeping the wing tips in their upturned positions are attached.

The fuselage of regular trapezoidal section with the wider base above is provided with a turtle back along its entire length. The flexing elevator forming a continuation of the tail plane divides the rudder into two sections each preceded by a small fin. Pilot and passenger sit in tandem, the latter being placed forward for observation purposes. The landing chassis of the Blériot type increases the great head resistance caused by the complicated bracing system. The Tauben, however, have a high degree of inherent stability.

The great majority of German biplanes belong to the Arrow type, so-called from the backward sweep of the planes. The lower plane is also given a slight dihedral angle as viewed from the front. Lateral stability is maintained by ailerons fitted to the upper plane only. Pilot and passenger are placed in separate cockpits as in the Taube. The top of the fuselage, which tapers to a vertical knife-edge at the stern, is covered with a turtle-back. Twin elevators are hinged to the stabilizing plane and the unbalanced rudder is preceded by a small fin. The tail planes are protected against contact with the ground by a short swivelling skid. The chassis is generally of the simplest type consisting of two pairs of streamline steel tube struts, each pair of which forms a V as seen from the side. A tubular axle sprung by rubber shock absorbers and carrying two disk wheels rests in the angle formed by the converging struts.

The rotary engine is almost unknown in Germany. The favorite motor is the 100 horse-power 6 cylinder vertical Mercedes, although 4 cylinder Argus motors of 100 and 150 horse-power are also much used. The motor is mounted on the bow of the fuselage driving a tractor screw. On the latest Rumpler Taube the Mercedes motor is inverted thus slightly lowering the center of gravity and improving the vision. The greatest difficulty, that of lubrication, has been surmounted. Twin radiators are generally employed, one being mounted on each side of the fuselage.

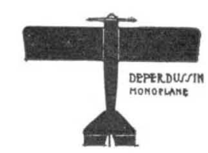
The Germans are certainly wise in employing the stationary motor, if only on account of its ability to withstand neglect. It is doubtful, however, if the vertical type will survive when higher powers are desired. The V type offers much greater freedom from vibration.

One of the greatest difficulties to be faced by the armies is the keeping up of aeroplanes in the field. In this respect France has the easiest task as St. Cyr and other permanent bases are comparatively near the central portion of the battle line. Incidentally these bases are also within range of German machines.

For weeks at a time machines have to be kept in hastily established aviation parks some distance behind the trenches. Of course all the nations have demountable hangars in use but it is equally certain that they are not in sufficient numbers to house a large proportion of the machines. It is not to be expected, therefore, that, between the enemy and the elements, aeroplanes last any great length of time. The wastage in fact is simply enormous and the factories of the countries at

*(Concluded on page 234.)*

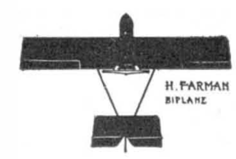
Deperdussin. *Monocoque fuselage of circular section cutting down head resistance to a minimum. Good entry is secured by very large stream lined tractor boss. Chassis consists of U-shaped stream lined struts from which is slung, by rubber shock absorbers, a tubular axle carrying a pair of disk wheels. Stabilizing plane is slightly cambered. Rudder is attached to small triangular fin.*



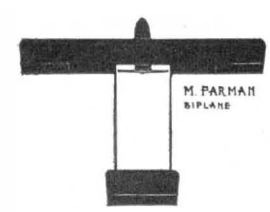

Nieuport. *Wings are of so-called Phillips' sections having reverse curve at rear. Rectangular fuselage is very deep in region of seats. These features are also employed in Ponnier monoplane, fastest machine in existence. Wing warping of Nieuport now accomplished by hand lever instead of foot bar. One model is armored and carries a mitrailleuse. Usual chassis consists of central skid and two wheels connected by steel leaf spring axle, but scout chassis resembles Morane.*


Morane. *One of the most popular machines in army. Fuselage tapers to horizontal knife edge at stern. There is no fixed stabilizing plane, but small tail fins are fitted on latest models. The two wheels of landing chassis are connected by an axle resting in angle formed by two pairs of converging struts. "Parasol" type monoplane also manufactured. In this model plane is over occupants' heads improving downward vision. Observer can also see upward as rear of plane is cut out.*

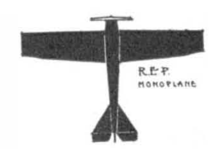

Henry Farman. *Pilot sits in bow, passenger behind him, both well ahead of leading edge of planes. Larger models have nacelle mounted on lower plane, but new scouting model has nacelle flush with upper plane. Center of gravity is thus very high, although lower plane has only 13 foot spread. Chassis is elementary, consisting merely of a wheel mounted at each end of lower plane. On larger models two sets of coupled wheels and short skids are used. Tail booms form a V as seen in plan.*




Maurice Farman. *Contrary to usual practice Renault V-type motor drives geared-down propeller. Nacelle mounted between planes so that line of thrust passes through center of gap. Upper plane has considerable overhang. Tail booms on each side meet at empennage. Twin rudders surmount monoplane tail, angle of incidence of which can be adjusted.*

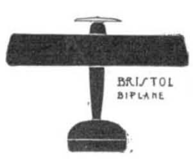



R. E. P. *Heavy, strong, and rather slow. Fuselage, of pentagonal section forward and triangular section in rear, is constructed entirely of steel tubes welded together. Tail plane to which elevator flaps are hinged is mounted flush with top of fuselage. Large tail fin renders machine very stable spirally. Steel chassis consists of two independent wheels and central skid.*




Avro. *Original fuselage tractor biplane. Newest models have staggered planes set at slight dihedral angle. Top of fuselage is fitted with turtle back. Chassis is composed of two wheels and central skid modeled after Nieuport. Balanced rudder is mounted between elevator flaps. A single-seater with back swept planes and a "pusher" type biplane similar to Grahame-White are also made.*


Bristol. *Rectangular fuselage is stream lined above and below. Planes are of peculiar section, being flat on upper surface between main spars. Tail plane on two-seater is set at negative angle, on single-seater it is parallel with line of flight. Rudder of large model is placed above undivided elevator. Chassis consists of four struts carrying two skids from which are sprung four wheels. Single-seater has two-wheeled chassis, staggered planes and divided elevator.*

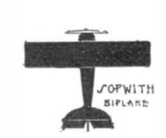



Grahame-White. *Resembles H. Farman practice except that four-bladed geared-down propeller is used instead of direct driven type. Simple two-wheeled chassis is used. On top of stabilizing plane is small fin supposed to counteract side area of nacelle, but it is too near main planes to have much effect.*

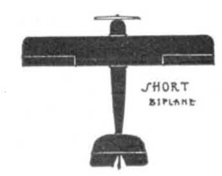
Vickers. *Passenger occupies front seat instead of being seated behind pilot as in Grahame-White. Tail booms are longer. Chassis consists of a couple of skids and wheels attached to a tubular axle. Ailerons are fitted to upper plane only, which has considerable overhang.*


R. A. F. *Lower plane is set at a dihedral angle which, with good weight disposition, gives a certain amount of inherent stability. Chassis consists of two long skids attached to fuselage by four struts. Axle carrying two wheels is slung from skids by rubber shock absorbers. Observation is not very good as passenger sits behind engine hood between planes. A 120 horse-power Austro-Daimler engine drives a four-bladed tractor through gearing.*


Sopwith. *Speed range from 36 to 92 miles per hour with pilot, passenger, and fuel for three hours. This with an 80 horse-power Gnôme. Chassis is similar to R. A. F. on smaller scale. Rectangular fuselage with turtle-back tapers to vertical knife edge at stern post to which is hinged balanced rudder. Pilot and passenger sit side by side, former being on left. Top plane is staggered forward 1 foot and has slightly greater angle of incidence than lower.*




Short. *Follows orthodox lines, but is larger than most British machines. Ailerons are attached only to upper plane, which has considerable overhang. Lower plane has Blériot shaped tips. Passenger and pilot sit in tandem, pilot to rear. There is no vertical tail fin, but empennage is placed well to rear. Chassis is composed of wheels and skids. Short Brothers with Sopwith are also noted as most successful manufacturers of seaplanes.*



# Improvised Means of Crossing Rivers

## Some Examples of Military Resourcefulness in Emergencies

THE crossing of streams during military operations is commonly effected by the use of trestle or ponton bridges built by the engineer corps. But in time of war it often happens that the services of the engineers are not to be had, and a detachment of cavalry, infantry, or artillery is obliged to cross a stream by any means that it can find. In France the infantry is skilled in constructing light bridges or footways upon barrels, or upon trestles, consisting of light poles driven into the river bed. Again, the men often have to cross streams upon improvised floats of various kinds.

Barrels can be very well used as a base for the bridge platform by lashing a number together in the shape of a raft. The best way is to use two ranges of barrels placed end to end, the raft thus being two barrels wide and half a dozen or more in length. Such a raft is held together by a timber framing 6 feet wide and 25 feet long. Then the rest of the bridge is laid in the manner of the usual raft bridge.

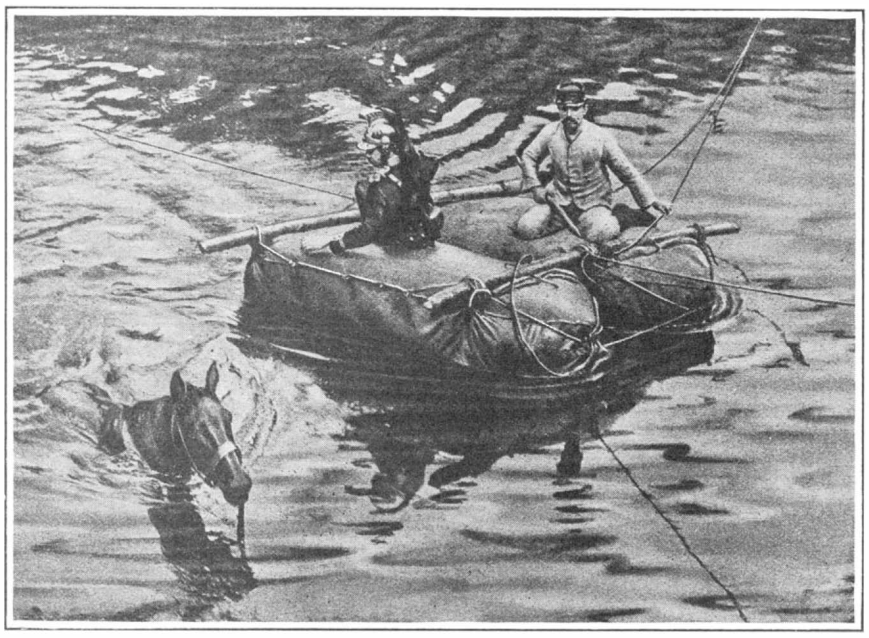
Trestle bridges can be constructed in a variety of ways, using either small tree trunks or other light timber, poles and the like, and each trestle has from 2 to 4 feet or uprights planted in the stream. When the stream is a shallow one, a practical and rapid method is to place wagons or carts in the stream for the supports, anchoring them in place with large rocks, and then running the bridge platform across them.

A good method of building a light foot bridge for infantry is to use standard army sacks filled with straw so that the sacks act as floats, and when laid close together they will support the planking for the footway. It is difficult to estimate the time required to build these different bridges, but for the footway run upon trestles three quarters of an hour is usually allowed for putting up a section 12 feet long upon four-pole trestles. Crossing of streams by cavalry is often done by even more primitive methods, and the troops are frequently put through exercises of this kind in order to have them well trained when it comes to emergencies. Should the horse be a good swimmer, he can carry the rider bodily across, but it is considered more prudent to let the horse swim alone, while the man also swims across. Non-swimmers go across upon rafts made up of tree-trunks or army sacks stuffed with straw or hay, these being hauled across the stream by ropes. On the raft is also placed the harness of the horses, as well as the men's clothes, assembled in packets. Untrained horses can be guided in tow by the men seated on the improvised raft, while the trained horses easily swim across without any attention. Usually the horses act with intelligence under such circumstances and the whole troop keeps together in good order.

Fording of streams is one of the most usual means employed for crossing, but of course this is limited to the smaller or shallow streams, and fords are very frequent here. For infantry crossing, a ford is practicable when the water is not over 3 feet deep, or 2 feet 6 inches, should there be a rapid current. Cavalry can cross at depths of 3 feet 8 inches, and vehicles at 3 feet to 2 feet 6 inches, should the river bed be solid and not muddy. In all cases it is the practice to run a hand rope across the ford upon poles. French troops have become quite accustomed to these maneuvers, and during the regulation army drills the chiefs lay out plans so that the men must cross the stream by swimming or otherwise, and once the habit is acquired, the troops have not the slightest hesitation to taking the water.

In the Austrian army special sacks of waterproof fabric are provided which can be blown up with air by simply using the mouth. These serve as pontons for light foot bridges. The sacks are said to answer all that is required of them in the way of floats, and do not suffer damage through use. An advantage in the use of this material is that the sacks are very light and can be carried on any kind of conveyance. On this plan, each regiment of infantry may be accompanied by enough material for laying out a 100-foot bridge, and this by using only one wagon, so that in actual war operations the army train would hardly be increased and the regulation engineer train would not be needed every time a small stream had to be crossed.

In the German army folding boats are made of canvas with improvised means for keeping them distended.



Bags of straw used as a raft by the French cavalry.

The accompanying photograph shows how cavalry lances are used for the gunwales and also as paddles to propel the craft. Three of these boats lashed together will carry an army wagon. The canvas boats may be folded up and packed on a horse.

### Fatalities at Coal Mines During 1914 Compared With Previous Years

IT is gratifying to note that the fatalities in coal mines in the United States in 1914 were 334 less than during the preceding year, the total number being 2,451, as compared with 2,785 for 1913.

The principal causes of accidents that show a material decrease were coal-dust explosions, 96 per cent; haulage, 11 per cent; and falls of roof and pillar coal, 10.6 per cent. The net decrease, in underground fatalities, was 365, or 14 per cent. This is equivalent to saving one life every day during the year.

There were 331 fatalities due to gas explosions as compared with 91 in 1913, making a net increase of 240. Of the total gas-explosion fatalities, 261 were due to four serious explosions. There were slight increases in accidents due to explosions and electricity. There was also a net increase of 26 fatalities in shaft accidents, or 42 per cent, while on the surface the net increase was five, or about 3 per cent. The net decrease for the year for both underground and surface accidents at coal mines as compared with 1913 was 12 per cent.

The exact figures for the number of men employed are not yet available, but taking the estimates as furnished by the inspectors for part of the States and using the same number of men as employed in 1913 for the other States, gives an estimated total number of employees for the year as 742,868, as compared with 747,644 in 1913. The fatality rate, therefore, becomes 3.30 per 1,000 men employed in 1914, as compared with 3.73 in 1913.

Excluding 1912, when the rate was 3.27 per 1,000 men employed, the 1914 rate of 3.30 per 1,000 is lower than any year since 1903.

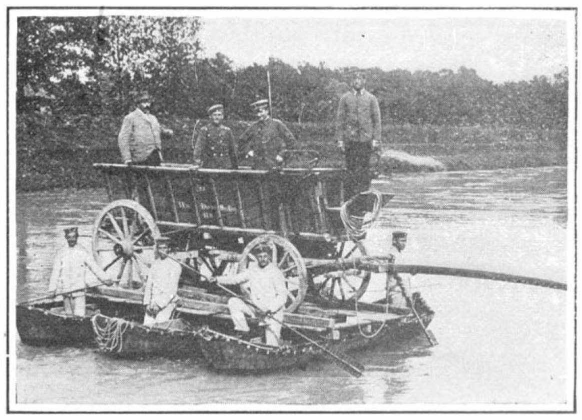
While there was a reduction of 12 per cent in the number of fatalities, there was also a reduction of 10.5 per cent in the production of coal. The United States Geological Survey estimates the production for 1914 as 510,000,000 short tons, as compared with 570,048,125 tons for 1913. The fatality rate per 1,000,000 tons of coal produced in 1913 was 4.89, and in 1914, 4.81. With the exception of 1912, when this rate was 4.41, the 1914 rate is the lowest yet recorded for the United States. The amount of coal produced per fatality in 1914 was 208,078 short tons, which, with the exception of 1912, is the largest on record. The production per fatality in 1913 was 204,685 tons; 1912, 226,469; and in 1907, 144,325 tons.

There were 316 lives lost in disasters in which more than five men were killed at one time, as compared with 464 in 1913, a net reduction of 148, or 32 per cent, in this class of accidents.

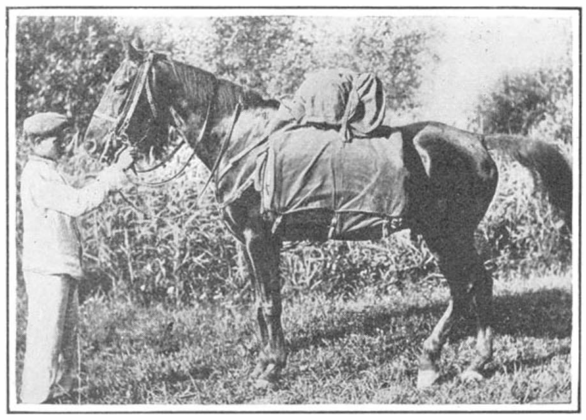
It is not possible to attribute these lower rates to any one particular influence. They may, however, be assigned in part to any one of the following agencies or to a combination of all of them: Closer and more careful inspection by the State inspectors; better enforcement of laws and regulations by the operators; realization of the dangers attendant upon the miner in his daily work and his efforts to reduce accidents due to the educational campaign conducted in his behalf; the extended use of safety lamps in doubtful mines; the use of permissible explosives; humidifying dusty mines; first-aid and rescue training, which saves lives that might otherwise be lost by reason of injuries received; the enactment of industrial accident compensation laws; and, last but not least, the spirit of co-operation on the part of all concerned.

### Improving the Race by Early Marriages

IN the various discussions of means for improving the human race one of the ideas propounded is that our "superior" man, that is superior mentally, should marry at an earlier age so that four generations might be produced in a century, even at the expense of delayed efficiency. The result of such system, it is pointed out, would be that at the end of the century two thirds of our population would be of the twenty-five year stock, and all presumably in comparison with previous generations produced at the rate of three generations or less to the century. To such theories exceptions have been taken by many, and in order to develop definite facts, Casper L. Redfield of Chicago, who maintains that early marriages that result in rapid generations lead to conditions that produce mental and moral defectives, offered last April to donate $100 to the American Genetic Association if it could be shown that any superior individual was ever produced by breeding human beings as rapidly as four generations per century; and considering the exceptionally great man of history he offered a second hundred dollars if a single one of them could be shown to come in the three generation class. Recently the association returned to Mr. Redfield the money he had deposited, no one having met the conditions announced.



Ferrying a wagon on folding canvas boats.



Folding boats packed on a horse.

Crossing a river on an improvised catamaran.

## Random Reflections

**By "Irresponsible"**

I MET a man a little while ago, an artist, writer, and one-time engineer, who informed me that there were no first-class minds in any of the arts to-day; they had all been absorbed by the sciences. This is one of those statements whose implications are more interesting than its assertions. Of course, on the face of it, it is open to several objections. We may deny that there are no first-class minds in art; or, admitting their absence, we may deny the existence of any first-class minds in science. Understanding by first-class, men of the Faraday, Darwin, Maxwell, Kelvin level, without ascending to world-shaking prodigies like Isaac Newton, we may very well ask what first-class minds exist in science at the present day. The late French mathematician, Henri Poincaré, was undoubtedly first-class—still, he is the *late* Henri Poincaré. Who else is there?

The average level of intelligence among scientific men at the present day is distinctly high, rather higher, perhaps, than the level among artists. And, to go off on a side issue for a moment, I had received the personal impression from my acquaintance with both artists and men of science, that on the whole the scientific man had a stronger character. He seemed to me calmer and better balanced. But since this war started (I knew the war would crop up somehow) I've become doubtful. Some of these frantic German professors! For instance, a celebrated professor at Heidelberg, a man whose work I have long admired, and who has trained English students by the score, advocates the destruction of Westminster Abbey, together with the tombs of the great dead of England. It reads like hysteria; where is the calm well-balanced character, elevated and fortified by a life-long devotion to science? And his voice is not the only one. There are enough of them to form a chorus.

I am afraid that scientific men have degenerated. About one hundred years ago another big war was raging, but it was between France and England. While it was going on the French Academy of Sciences bestowed a medal upon an English scientific man for his distinguished services to science. One cannot help admiring that. That is exactly the attitude which becomes a scientific man, and which dignifies science. We must preserve that spirit. We must have a few men who remember first that they are members of a collection of curious little two-legged animals without feathers, called the human race, and only secondly that they happen to exist on some particular corner of the planet earth, that common dwelling place of all their kind. An excessively patriotic man, like an excessively anything else, is merely a man with a defective sense of proportion. And a defective sense of proportion is—well, it's a pretty generally accepted definition of lunacy. But that is a side issue. I was talking about the arts and sciences. I don't think it can be shown that first-class minds at the present day take up science rather than art. As I have said, I am, to start with, a little doubtful about the existence of the first-class minds. But letting that pass, and supposing that by analyzing the psychology of a scientific man's work one can show that he is a really, in temperament and intimate mentality, an artist. Suppose he is invariably interested, not in the results he obtains, but in the beauty of the methods by which he obtains those results. Roughly speaking, that would be different from the scientific mind as it is generally understood. Well, I think there are such scientific men. But I think there are quite as many artists who are more interested in results than in beauty. Take a writer like H. G. Wells. He is particularly interested in writing novels which illustrate the influence of social surroundings upon various characters, including in social surroundings other human beings. In any particular case such an investigation is scientific in character, and in reading Mr. Wells one certainly gets the impression that he is much more interested in conducting that investigation faithfully and vividly than he is in producing a finished and beautiful piece of literature. He is distinctly more interested in what he is saying than in the manner in which he says it. He is a scientific man using as his medium the novel rather than the psychological or sociological treatise.

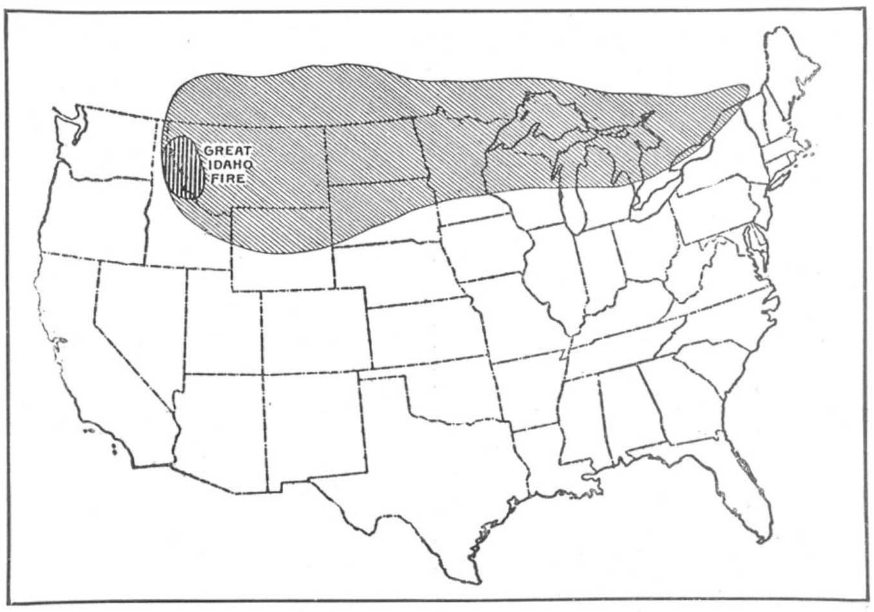
Mr. Wells does not stand alone. Various other names could be mentioned. Personally I think this extension of the scope of the novel a highly important and desirable phenomenon. Scientific investigations can be presented in the form of a novel which could not be effectively presented in any other way. Before a sound scheme of society can be built up we must know an immense amount about personal and social psychology. Besides the professor, we require for the proper investigation of these two subjects the man of insight and imagination. We require the novelist. Because his methods are, in a way, looser and more general, they will probably prove more valuable. And, a little fact not without its importance, he can influence an incomparably greater public. So that, in view of the existence of this kind of novel, and of one or two other indications of a similar kind, I should feel disposed to say that artists and men of science share the arts and the sciences pretty equally. To some extent the two things merge into each other. There are stylists in science. To me, for instance, there is some resemblance in style between the work of Abel, the Norwegian mathematician, and that of Chopin, the Polish musician. But I admit that I experience difficulty in making the resemblance clear to other people.

## Dark Days and Forest Fires

**By C. F. Talman**

INSTANCES of daytime darkness are recorded in the old chronicles along with such other "prodigies" as multiple suns, showers of blood, and warring armies in the sky—all of which can easily be identified to-day with well-known meteorological phenomena (parhelia, rain reddened with desert dust, and the aurora). The two famous cases mentioned in the Bible—the plague of darkness in Egypt and the darkness attending the crucifixion—illustrate the fact that such occurrences were once universally assumed to be miraculous.

Some of the early cases of daytime darkness mentioned in history are doubtless attributable to solar eclipses, and must, accordingly, have been restricted to a small part of the earth's surface, and have been of but a few minutes' duration. The majority of the famous "dark days" were, however, the result of an abnormal accumulation of smoke or dust in the air, sometimes arising from burning forests, moors, or prairies, sometimes from volcanic eruptions, and in many instances covering vast areas of the globe.




**Area in which dark days occurred, caused by smoke from the great Idaho fire, August 20th to 25th, 1910.**

In a recent publication on "Forest Fires" (*Forest Service Bulletin 117*), Mr. F. G. Plummer gives the following list of dark days in the United States and Canada:

1706—May 12th, 10 A. M., New England.
1716—October 21st, 11 A. M. to 11:30 A. M., New England.
1732—August 9th, New England.
1762—October 19th, Detroit.
1780—May 19th, New England. (Black Friday. The Dark Day.)
1785—October 16th, Canada.
1814—July 3rd, New England to Newfoundland.
1819—November 6th to 10th, New England and Canada.
1836—July 8th, New England.
1863—October 16th, Canada. ("Brief duration.")
1868—September 15th to October 20th, Western Oregon and Washington.
1881—September 6th, New England. (The Yellow Day.)
1887—November 19th, Ohio River Valley. ("Smoky Day.")
1894—September 2nd, New England.
1902—September 12th, Western Washington.
1903—June 5th, Saratoga, N. Y.
1904—December 2nd, 10 A. M., for 15 minutes, Memphis, Tenn.
1910—August 20th to 25th, Northern United States, from Idaho and Northern Utah eastward to St. Lawrence River.

Forest fires are the common cause of dark days in this country. The fact that such days are most frequent in the Northeastern United States and Eastern Canada is evidently related to the fact that practically all barometric depressions ("lows"), with their attendant whirl and indraft of the surface air, pass down the St. Lawrence Valley on their way to the ocean, and usually become intensified and sharply defined in this region. The smoke from a conflagration anywhere on the periphery of a "low" is drawn into the vortex along more or less converging lines, and at the same time rises to a considerable altitude. Eddies in the circulation of the "low" will result in a dense accumulation of the smoke in places, and this may occur above the level of the lower clouds, which thus mask the cause of the phenomenon. Hence the startling effect of darkness in the daytime, often with little or no turbidity of the air near the earth's surface. Mere smokiness of the air near the ground or a fog heavily charged with smoke (as in the case of the London fogs), however great the obscurity produced, would hardly be placed in the same class with the awe-inspiring dark days of the chroniclers. If, however, showers occur during one of these occurrences, a large amount of soot is likely to be brought down, and thus we have another "prodigy"; viz., "black rain." A very recent case of this sort is reported in the *Quarterly Journal of the Royal Meteorological Society* for October, 1912; during a thunderstorm in Eastern Hampshire darkness almost like that of night occurred in the early afternoon, and inky rain fell. The phenomenon was due to soot carried from London, fifty miles away.

When the pall of smoke is rather thin a certain amount of sunlight struggles through, and owing to the same process that gives us the golden glow of sunset a yellow or coppery tinge is cast over the landscape. This effect has been noted in connection with several dark days, including the most famous of all, that of May 19th, 1780. It was the principal feature of the dark day of September 6th, 1881, in New England, which is accordingly known as "the yellow day."

The great Idaho fire of August, 1910, was responsible for dark days over an area larger than in any other case on record in this country. The accompanying chart, from the *Forest Service Bulletin* above mentioned, shows the area in which artificial light was used in the daytime, but smoke was observed far beyond these limits. The British ship "Dunfermline" reported that on the Pacific Ocean, 500 miles west of San Francisco, the smell of smoke was noticed, and haze prevented observations for about ten days.

## Restoring Fatigued Muscles

A VERY ingenious physiological method of increasing the yield of labor from any given group of muscles is described in the *Deutsche Revue*. According to an abstract in *Die Umschau*, the author, Th. Weber, claims that in practice a gain of from 22 to 40 per cent is obtainable in the amount of work done. The device is extremely simple. When the given group of muscles has reached the point of exhaustion, due to the accumulation of the products of fatigue, they are allowed to rest, while an entirely different muscle group is set to work vigorously. The energetic contraction of these muscles causes an increase in heart action and circulation, and the strengthened current of blood thus sent to all parts of the body partially restores the working power of the first group of muscles by carrying away fatigue toxins and supplying oxygen.

## Automobile Fire Department Outfits

AN automobile fire engine of improved type was lately delivered by an English maker to Athens on the order of the Greek government. The present outfit, although very effective, is equipped with a 60 horsepower engine and turbine pump, but it is light enough to run on rubber-tired wheels. Another outfit produced by the same concern consists of an automobile hook-and-ladder supply car, seven of which are now in use by the London fire brigade. They are fitted with 30-gallon chemical tanks, hose reel and telescoping ladder, and are especially good for first aid work. It will be observed from the first-mentioned outfit that the rotary pump is coming into favor for fire engines. Such pumps are also in use on the Paris fire engines.

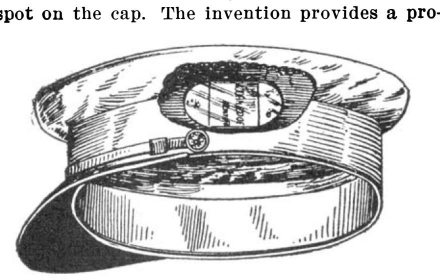
**Darwin Relics.**—The late William Erasmus Darwin, who was a son of Charles Darwin, recently left a number of relics of his famous father to his nephew, with the request that they be kept permanently in the possession of the Darwin family. These relics include the family portraits, many medals that had been presented to his father, the letters written home by him while on the "Beagle" expedition and two early sketches of "The Origin of Species."

## RECENTLY PATENTED INVENTIONS

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

### Pertaining to Apparel.

CAP PROTECTOR.—Y. M. MARKS, U. S. Army, General Hospital, Presido, Cal. This invention has reference more particularly to the type of cap used in the U. S. Army, the crown of which, when the cap is worn, touches the head of the wearer, resulting in a solid spot on the cap. The invention provides a pro-



CAP PROTECTOR.

tector having an effective attaching means for the convenient and secure application of the protector to the crown of the cap, at the inside. The protector provides for holding a removable card or identification tag between the protector and the crown of the cap.

COMBINATION SHIRT AND VEST.—C. MARCUS, 580 Broadway, New York, N. Y. The invention provides a shirt with vest fronts or sections in such manner as to eliminate the necessity of wearing a vest separate and apart from the shirt and with an independent back, the invention more particularly residing in the construction of the vest fronts and ways and means for attaching the same to the vest.

GARTER.—E. B. WINTERS, 815 Union St., Coffeyville, Kansas. This invention provides a very comfortable garter, as the pressure due to the pad is well distributed, and the pad as a whole has an amount of resilience and yieldability conferred upon it by the spring, and adapted to equalize the pressure exerted by the pad upon the wearer's leg. Mr. Winters has invented another garter, having an inelastic band in which he locates the coil springs in line with the tension brought to bear thereon through the leg band, and said springs are also located at the point of greatest possible separation of the shield branches, whereby great latitude of garter expansion results, this being advantageous when a wearer bends his leg at the knee. This inventor has also invented another garter in which, while still employing the inelastic bands, bifurcated shield, and yoke-spring, the spring arms are firmly secured to the shield, one end of the band is permanently secured to the shield, and the other end thereof is in detachable connection with the shield.

CONVERTIBLE GARMENT.—AMELIA B. WELLS and MATILDA BLICKHAN, 121 W. 88th St., New York, N. Y. The object of this invention is to provide a convertible garment more especially designed for woman's wear which can be readily converted by the owner into a house dress, empire gown, street dress, ball-room dress, belt waist dress, and loose back wrapper.

MATERNITY SKIRT OR DRESS.—B. SCHIFF, 119 W. 25th St., New York, N. Y. The garment is open at the front and is provided with a waistband having non-elastic front portions and a gathered hem at the back, and draw strings in the said hem and secured at the middle of the back and extending out of the hem at the forward ends thereof, and a retaining means on the said front portions of the waistband and to which the outer ends of the draw strings can be tied.

LIFE PRESERVING SUIT.—W. J. KARBAN, R. F. D. No. 1, Bryant, Wis. The features of novelty are the construction of the mouth-piece and its side attachments controlling the admission of air to support respiration, and of means for clamping and tightly closing the openings in the legs and crotch of the suit, which opening is required to permit application of the suit to a person.

SHOE SHINING MACHINE.—F. V. MURPHY, 912 Franklin St., Bay City, Mich. This inventor provides a coin-controlled machine for polishing shoes, either black or tan, and wherein mechanism is provided for polishing the shoes, adapted to properly polish shoes of varying sizes, and wherein the mechanism is so arranged, that by inserting a coin of the proper denomination the polishing machine will be set in operation.

### Electrical Devices.

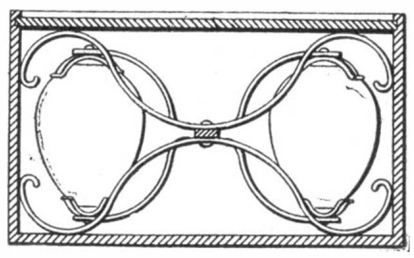
ELECTRIC FIRE ALARM.—W. E. HOWELLS, 743 Pleasant Ave., Peckville, Pa. This invention relates to an electric fire alarm of that type, including a heat responsive device, which at a predetermined rise in temperature of the atmosphere will close an electric circuit including one or more alarms or other warning devices.

METALLIC ELECTRIC WELDER.—W. H. DRALLE, 1010 24th St., Watervliet, N. Y. This invention relates to the art of electric welding, wherein the active electrode is a metal rod or wire which is so held that one extremity becomes the one element of the welding arc, while the other element is the work to be welded.

ELECTRIC IMPLEMENT.—L. PAULERO. Address American Electric Tool Co., Petersburg, Va. An object of the inventor is to provide a device especially adapted for cutting and carving stone, driving rivets, clipping and caulking, hammering, and, in fact, wherever it is desirable to employ a tool having a reciprocating motion.

### Of Interest to Farmers.

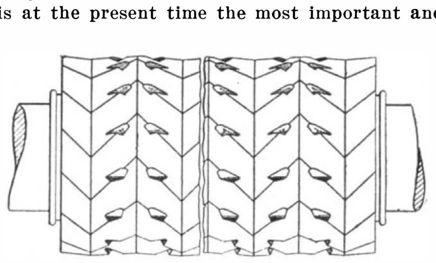
EGG CARRIER.—E. DUERR, 524 West St., Kensington, Brooklyn, N. Y., N. Y. This invention relates to improvements in egg carriers, and has for an object to provide a structure which will resiliently support eggs in a



EGG CARRIER.

container. It provides a resilient support for eggs which will hold the eggs spaced apart and will press against the ends of the eggs, whereby the strain on the eggs is brought at their strongest point.

ROLLER.—L. G. G. DIBBETS, The Hague, Netherlands. The invention relates to improvements on the rollers used in the Krajewski crusher, which is utilized for crushing and cutting sugarcane before the same enters the ordinary three-roller mill. The Krajewski crusher is at the present time the most important and



ROLLER FOR SUGARCANE.

successful accessory designed to increase the efficiency and output of any form of cane-grinding plant to which it may be applied. This contrivance acts both as a crusher and as a preparer and equalizer of the feed of the cane as it enters the mill, and is now generally used in connection with the train of multiple mills.

WOOL COMBING MACHINE.—T. H. FRIEND, care of American Woolen Co., Lawrence, Mass. In carrying out the invention a friction wheel in the form of an idler is mounted on a suitable supporting means which maintains the idler in engagement with the driving and the driven belt pulleys so as to cause an effective transfer of power, the supporting means being so designed as to be readily applied to the machine.

COMBINED POULTRY ROOST AND VERMIN TRAP.—G. WOODALL, 130 South Ave., Davenport, Iowa. The invention relates more particularly to that type in which the bars thereof embody traps for entrapping vermin that affect chickens and other poultry. It is well known that chicken lice and other vermin are in the habit of secreting themselves in small cracks in the roosts during the daytime when the roosts are unused.

VENTILATED CAN CLOSURES.—O. P. L. OLSEN, Box 274, Eugene, Ore. This invention relates more particularly to a cream can closure. One of the principal objects is to provide a can closure by means of which the contents of the can may be ventilated without danger of the admission of mice or other animals or insects into the can.

SUPPORT AND PROTECTOR FOR FRUIT BEARING TREES.—W. R. WINANS, Winans City, *via* Hood River, Ore. The netting conforms to the shape of the tree. The strands composing the netting come in contact with, and effectually support, the extremities of the limbs, and thus indirectly support the fruit attached to, and pendent from, such limbs; yet the netting does not interfere with the passage of light, air, or moisture, so that the ripening of the fruit proceeds the same as if the netting were not applied.

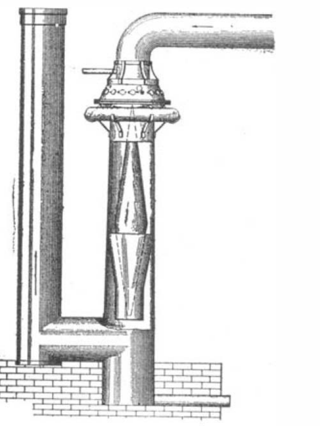
### Of General Interest.

NURSING BOTTLE HOLDER.—I. REYMAN, 23 South Main St., Port Chester, N. Y. The invention relates to brackets for special purposes, and especially to brackets for holding nursing bottles in connection with infants' cribs, cradles, carriages, or the like. The device may be readily clamped securely in any ordinary position in which it may be desired to be used.

COMBINED POST AND TENSION DEVICE FOR WIRE FENCES.—C. D. BENNETT, Scipio, Ind. This invention relates to wire fences and has for an object to provide a combined corner post and tension device adapted for either portable or stationary fences. By this invention the wires of a fence can be quickly secured in position and any desired tension given to them.

BOTTLE STOPPER.—A. MOTRONI, 74 Columbus Ave., New York, N. Y. This invention has reference to improvements in bottle stoppers, and has for an object to provide an improved structure which is adapted to maintain a bottle closed except during the time that fluid is being discharged therefrom.

SMOKE DISPENSER.—M. MOSER, care of General Delivery, Seattle, Wash. This invention relates to smoke dispensers of the type in which the smoke, formed in a furnace or analogous structure, is brought into contact with a liquid and thus prevented from being set free in the atmosphere. The inventor seeks



SMOKE DISPENSER.

to provide a dispenser adapted for general use, but of peculiar service in connection with smelting furnaces and other analogous devices, and so arranged as to bring the smoke into contact with water under such conditions as to cause the smoke to be absorbed by the water.

STIRRUP.—G. D. COOIER, Waynesboro, Va. In this case provision is made for flexibility and springiness while riding, in order to reduce sudden shock, and the object of the invention is to provide such an arrangement and means by which the play or flexibility of the parts is limited in order to prevent their excessive action when mounting.

SEAL.—J. KLEIN, Box 49, Route No. 2, Tampa, Fla. This seal is for use on trunks, suit cases, and articles of a similar nature. The invention provides a seal which is capable of quick and easy manipulation, and which will hold the article to which it is attached firmly locked and secure against undetected tampering.

LOCKING RECEPTACLE FOR MILK BOTTLES.—C. NAHABEDIAN, 445 E. 179th St., Bronx, N. Y., N. Y. The invention provides a receptacle having a lock which may be operated to release only when removed from the station in which it is placed; provides a receptacle, the mechanism whereof is simplified to reduce the cost of construction and avoid disarrangement; and provides a receptacle having facilities for carrying bottles in locked position.

PROCESS FOR PRODUCING PERFORATED TUBULAR ELECTRODES FOR ACCUMULATORS.—J. KRANNICHFELDT, Cologne-Niehl, Germany. This invention comprises a process for producing electrodes for accumulators which consists in covering the openings of the tubes with paper on the inside of the tube, filling said tubes with active mass, hardening said active mass and accelerating the destruction of the paper by filling the accumulator formed by said tubes with a strong acid.

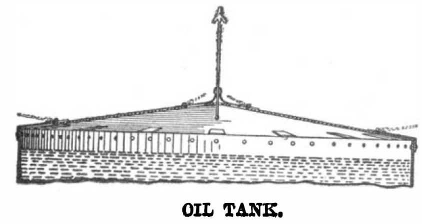
HIGH FREQUENCY THERAPEUTICAL APPARATUS.—F. M. KIDDER and M. H. KIDDER, 820 Broadway, New York, N. Y. This invention provides a handle for the apparatus with a flexible supply cord, the handle having novel means on its ends whereby the cord when not in use can be wound around the handle lengthwise thereof, whereby the wire is prevented from kinking or becoming entangled.

PROPELLER.—C. T. A. H. WIEDLING, 124 26th St., Guttenburg, N. J. The invention relates to rotary propellers for ships, balloons, flying machines and similar vehicles, and it is also of equal usefulness for other devices and machines like turbine motors for steam, water, wind, air or gas power, or like turbine pumps, turbine air compressors, blowers, and fans.

LIQUID DISTRIBUTING DEVICE.—C. RISACHER and P. A. HÉBERT, 58 Boulevard Pasteur, Paris, France. The device according to this invention consists of a tube connected with the source of the supply of liquid and on which are branched lateral ajutages or spouts, in combination with a porous or fibrous material, such as wicks, which fill the bore of the tubes and spouts. The device can distribute any sort of liquid.

COMPOUND BINDING STAY.—H. DE HAVEN, 52 Columbia Heights, Brooklyn, N. Y., N. Y. The improvement provides a reinforcing stay more especially designed for use on light wooden packing boxes and like receptacles, and arranged to permit of quickly and conveniently attaching the stay to the box without the use of a large number of nails or similar fastening devices.

OIL TANK.—E. A. WASSON and F. M. COOLEY, 566 Crockett St., Beaumont, Tex. This



OIL TANK.

invention provides an oil tank with means for allowing the escape of exploded gases, when the gases are ignited by lightning or other sources. It provides an oil tank having outlet valves, and means for causing the explosion of the gases contained within the tank upon lightning striking near the tank, the valves being adapted to open to allow the escape of the explosive gases, and then to shut whereby to cut off the supply of air, thus smothering the fire.

BOTTLE ATTACHMENT.—J. B. CLAYTON, 1025 Hillen St., Baltimore, Md. This attachment is adapted for connection with the neck of a bottle, especially those containing poisonous substances, and having means for encircling the stopper of the bottle to prevent the removal of the stopper without striking the attachment to warn the person holding the bottle concerning its contents.

DISPLAY APPARATUS.—C. BOUDREAUX, Marathon, Tex. The improvement provides an apparatus especially adapted for holding articles packed in independent boxes, in such manner that any particular box will be accessible for examination or removal without changing the position of any other than the box to which access is desired.

### Hardware and Tools.

CROSSCUT SAW.—R. W. GRAVES, 900 East Jersey St., Elizabeth, N. J. This saw is especially designed for cross-cutting purposes, such as felling trees, sawing felled trees into the desired length, sawing lumber and the like, and arranged to allow convenient and quick adjustment of the saw blades for sawing work of different diameters, to cut the work by two blades from opposite sides, and to hold saw blades with the desired tension in engagement with the work without pressure on the part of the operator.

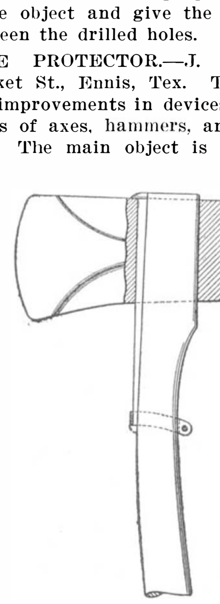
HOSE PIPE COUPLING.—H. R. VAN METER, 1163 E. 12th St., Los Angeles, Cal. This invention provides a means for coupling hose-pipe sections or hose-pipe and plugs provided in water supply systems; provides means for rapidly connecting said sections or sections and plug; and provides means, automatically adjustable, to accommodate couplings of different sizes or conditions.

MOP WRINGER.—W. H. WELCH, Alba, Mich. This invention relates to means for forcing water out of mops, and it accomplishes this result by squeezing the entire mop at one time, rather than by drawing the same between rollers, or by twisting the same, whereby no injury occurs to the mop. The mop is easy to operate and the wringing efficiency is remarkable, even up next to the handle. It can best be made out of stamped steel.

SHOWER BATH BODY.—F. BOCKELMAN, 162 East End Ave., New York, N. Y. The object of this invention is to improve the construction of what is known in the trade as a shower bath body, whereby the same is not only rendered more neat and graceful, but is of superior strength and lasting qualities, said structure being made preferably of a unitary or one piece casting, whereby unnecessary joints which tend to weaken the device are avoided.

GAGE FOR HINGES.—J. F. GODEFROY and A. J. KUGLER, 210 W. 146th St., New York, N. Y. An object here is to provide a universal compact gage or tool by means of which holes to be drilled in the object to be hinged will direct the drilling tool at a proper angle to the face of the object and give the required distance between the drilled holes.

HANDLE PROTECTOR.—J. HOLIK, 602 East Crocket St., Ennis, Tex. The invention relates to improvements in devices for protecting handles of axes, hammers, and other similar tools. The main object is to provide a



HANDLE PROTECTOR.

device for protecting the handle of a tool, such as an ax, and for stiffening it at its weakest point. The invention provides means for preventing the head from flying off the handle.

### Heating and Lighting.

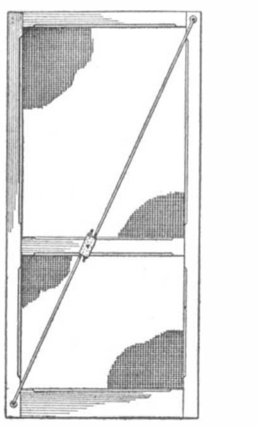
CANDELABRUM.—D. H. LIND, care of Morris Wolf, 302 Broadway, New York, N. Y. The invention provides a candelabrum having the candle holders provided therefor, constructed without the use of materials which melt or are otherwise deleteriously affected by heat; provides means whereby the holders commonly employed for supporting candles may be converted into holders for wicks; and provides reservoirs or receptacles for oil to be supplied to said wicks.

**Household Utilities.**

PORTABLE CLOTHES REEL.—J. T. Pilkington, R. D. No. 4, Armstrong, B. C., Canada. The design in this case is to provide a reel in which the several arms may be revolved separately or in unison; in which the respective arms may be turned to bring them into vertical alinement whereby the reel may be run through a doorway or be conveniently placed on a veranda or in compact form adjacent to a building.

**Household Utilities.**

BRACING DEVICE FOR SCREEN DOORS.—P. Christensen, 501½ E. Washington Ave., Argenta, Ark. The invention provides a device which can be made at small cost and which will effectually brace the door without adding materially to the weight thereof. It provides a device which may be adjusted to doors of different sizes, since it is provided with means whereby the bracing device may be



BRACING DEVICE FOR SCREEN DOORS.

lengthened or shortened within limits. In this device the bracing of the upper and lower portions of the door may be independently effected.

OVERLAP SHOWER RING.—G. F. Colter, 419 W. 119th St., New York, N. Y. The ring is provided with an overlapped portion. This may be connected or separated as desired, but must overlap to such an extent as to allow a curtain to present a substantial overlap for entirely closing the opening. The ring may be supported by any suitable standard, and may have a spraying device associated therewith of any desired form. The entire outfit may be arranged above a bath tub or other suitable place.

**Machines and Mechanical Devices.**

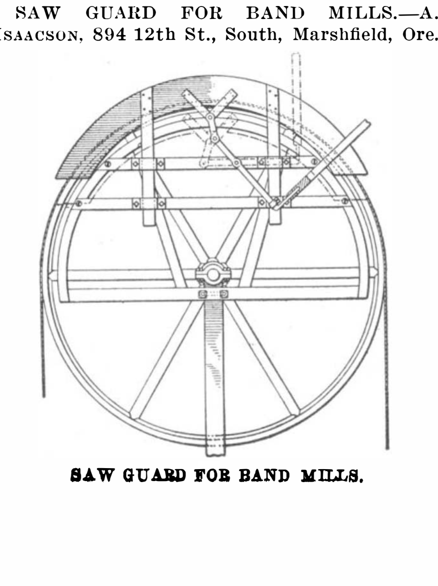
DROP HAMMER.—R. Grosdidier, Société Anonyme des Forges et Aciéries de Commercy, Commercy, Meuse, France. For the purpose of avoiding many inconveniences, the present invention consists in providing a disconnection, no longer by the direct action of the mass on the clutching device on the arrival of such mass at the top of its throw, but by the action of an auxiliary clutching device which acts in antagonism to the usual clutching device, and which is more powerful than the latter, such auxiliary device being trussed and locked in position during descent of the mass and then released by the latter on its return to the top of its throw.

ROAD BUILDING MACHINE.—J. H. Moore, Jr., 149 Pioneer St., Brooklyn, N. Y., N. Y. This invention provides a machine arranged to continuously mix and deliver road-building materials; provides a machine for manually controlling the distribution; provides such a machine with self-contained traction mechanism; provides means for supplying the machine with raw materials; and provides means for measuring the raw materials for mixing.

DEVICE FOR DELIVERING TOBACCO TO CIGAR AND OTHER SIMILAR MACHINES.—E. Belot, 319 Rue de Charenton, Paris, France. In the present patent the invention has reference to devices for delivering tobacco cut up into short and dry lengths to form the interior of machine-made cigars, or for supplying material to any other similar machine.

CAN TOP DROPPER.—C. E. Forry, care of H. L. Guenther, 310 North Ave. 19, Los Angeles, Cal. In the present patent the object of the inventor is the provision of a simple, economical, and efficient device for dropping can tops one at a time and delivering them to any suitable feeder for feeding them mechanically to a can-topping machine or the like.

SAW GUARD FOR BAND MILLS.—A. Isaacson, 894 12th St., South, Marshfield, Ore.



SAW GUARD FOR BAND MILLS.

This invention is an improvement in saw guards and catchers for band mills, and has for its object to provide a device capable of adjustment for various conditions, and wherein mechanism is provided for catching the saw should it run off the band wheel, and for preventing the running of the saw into the saw pit, to prevent damage to the saw, and to safeguard the sawyer.

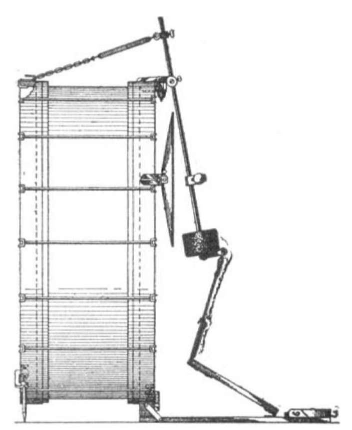
CONVEYER.—J. J. Phillips, Brookhaven, Miss. The invention provides a conveyer more especially designed for carrying clay or similar materials from a receiving hopper to a dry pan, and arranged to permit convenient arrangement of the amount of the material to be delivered to the dry pan according to the condition of the material at the time.

MAIL BOX.—C. E. Utterback, Lock Box 201, Mooresville, Ind. The more particular purpose in this case is to provide a device having improved means for safe-guarding mail placed in the box. The box constitutes a safe repository and one which may be easily and quickly opened and closed. Mail placed therein will be cared for and held so that when the main door is lowered and supported, the mail may be readily withdrawn.

COAL LOADING DEVICE.—W. W. Jamison, Greensburg, Pa. An object here is to provide a device having a movable chute which may be thrust forward into the loose coal, and means for elevating the latter into the car. A further object is to provide means for permitting the swinging of the chute to one side or the other without interfering with its forward and backward movement, thereby increasing the range of operation of the chute.

**Musical Devices.**

COMBINATION DRUM AND CYMBAL BEATER.—J. Hubmann, 2255 South Jefferson Ave., St. Louis, Mo. This invention relates to a combination drum and cymbal beater and has for its object the provision of a contrivance of



COMBINATION DRUM AND CYMBAL BEATER.

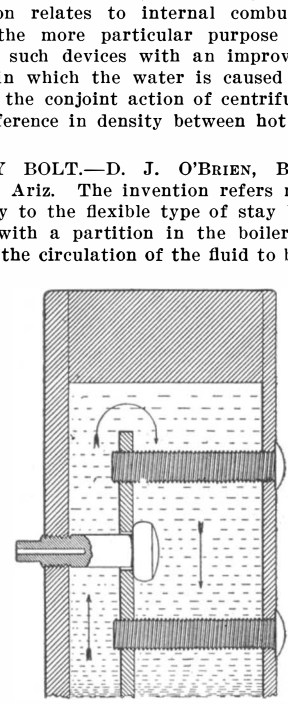
this character by which a drummer seated can play a bass drum and cymbal with one foot, leaving his hands free to play a snare drum or other effects or instruments necessary for an up-to-date trap drummer.

PEDAL ACTION FOR PLAYER PIANOS.—C. H. Ladew, Sr., 1879 Clinton Ave., Bronx, N. Y., N. Y. This improvement provides a pedal action for player pianos, arranged to control the hammer rail of the piano action in the usual manner when playing the piano by hand, or to permit of actuating the bellows from the same pedals when using the instrument as a player piano.

**Prime Movers and Their Accessories.**

INTERNAL COMBUSTION ENGINE.—C. Stiriz, 2577 8th Ave., New York, N. Y. The invention relates to internal combustion engines, the more particular purpose being to provide such devices with an improved water jacket in which the water is caused to circulate by the conjoint action of centrifugal force and difference in density between hot and cold water.

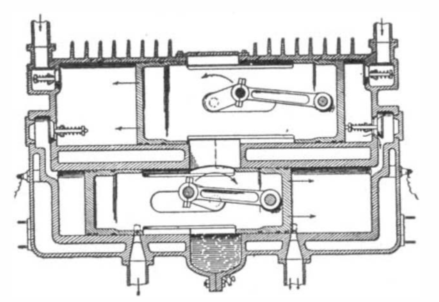
STAY BOLT.—D. J. O'Brien, Box 1002, Jerome, Ariz. The invention refers more particularly to the flexible type of stay bolt associated with a partition in the boiler for perfecting the circulation of the fluid to be heated.



STAY BOLT.

It provides a stay bolt and partition of simple, strong, and durable construction, which bolt has means for readily indicating any injury thereto, and which will insure at all times a universal tensile strength.

INTERNAL COMBUSTION ENGINE.—T. I. A. Tomasini, Cayucas, Cal. This inventor provides a device which has a plurality of cylinders, and in which the explosions take place in regular succession. He also provides a novel form of device in which there is an auxiliary



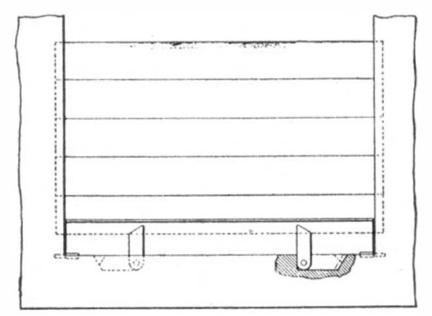
INTERNAL COMBUSTION ENGINE.

compression cylinder for each explosion cylinder, the compression cylinder not only acting to compress the charge preparatory to firing the same, but also acting as a compression means for the efficient scavenging of the cylinder after the explosion has taken place.

**Railways and Their Accessories.**

KILN CAR.—C. E. Evans, Weed, Cal. The car has a movable stake connected by links with a stake secured to the body of the car, one of the car wheels being journaled to a lever fulcrumed to the car body, and this lever engaging a member at the bottom of the movable stake, so that the weight of the material on the body will serve to move the body down relatively to the lever, thereby moving the movable stake relatively to the stake secured to the body, for pressing the lumber against another stake.

GRAIN CAR DOOR.—W. B. Nicoll, care of W. L. Morton, Fort William, Ontario, Canada. The invention relates to grain cars used for transporting grains of varying kinds. Among the advantages of this invention are: 1. To simply use the threshold plate or toeplate (which is on every car) as a sure and efficient grain-release. 2. It does not matter in which way the door above the plate is adjusted, as it



GRAIN CAR DOOR.

is bound to come out intact when the pressure of the grain is taken from behind it on letting the plate down. There is no excuse whatever to destroy the door. 3. It places in the hands of the railway companies a means of release in permanent connection with their cars which puts them in a position to demand damages for any injury to their doors in the process of unloading grain. It is easier to let down the plate than to break through the door.

RAILWAY TIE.—T. M. Daniels, 327 South La Salle St., Chicago, Ill. This invention relates to railways, and the object thereof is to provide a tie for the tracks which not only positively maintains the tracks in relationship with each other, but which also support the tracks in a yielding or resilient manner.

AUTOMATIC TRAIN STOP.—F. G. Bastian, 62 Bloomfield Ave., Buffalo, N. Y. The invention provides means for releasing the air in the train line of the brake system, to reduce the pressure in the train pipe for applying the brakes, by partially exhausting the air into an exhaust reservoir instead of directly into the atmosphere, whereby the pressure in the said reservoir and train pipe will be equalized after the brakes have been applied and the train stopped.

RAIL JOINT.—T. B. Strother, Catherine, Ala. This improvement provides means for connecting abutting rail ends, wherein the connection is so arranged that it will rigidly support the rail ends in alinement and in register, and wherein the connection will also prevent creeping of the rails with respect to the ties.

**Pertaining to Recreation.**

SCREEN FOR MOVING PICTURES.—J. H. Genter, Newburgh, N. Y. The invention relates to screens for receiving and projecting images, such as those of stereopticons or moving picture machines. An object is to provide a screen which is actually made up of a series of strips, but which appears to be a unitary structure without any screens. The screen will not subject the eye to strain, glare, or haze.

AMUSEMENT APPARATUS.—W. F. Mangels, Coney Island, Brooklyn, N. Y., N. Y. This invention relates to an amusement device adapted for popular resorts and is of that type in which passengers ride in a car which has a predetermined motion tending to produce amusement and merriment for the occupants and spectators.

**Pertaining to Vehicles.**

ATTACHMENT FOR STEERING WHEELS.—V. A. Asplund, Glenburn, N. D. The invention relates to a hand rest or gripping attachment applicable to the periphery of a steering wheel, to afford positive abutments or resistance members to prevent the operator's hand from slipping on the wheel, and to enable him to obtain a better grip.

AUTOMATIC ENGINE SPEED GOVERNOR FOR VEHICLES.—T. Douglas, 80 Maiden Lane, Scarboro, N. Y. This invention relates to engine governors of the automatic type and adapted to be used between the throttle and inlet or inlets of an engine and operatively connected with the speed shaft of the engine or some moving part of the machine driven thereby, or with both, whereby the speed will, when excessive speed is attained, cut down the supply of elastic or explosive fluid to the engine for controlling the speed thereof.

POWER TRANSMISSION MECHANISM FOR AUTOMOBILES.—M. L. Senderling, 333 Fairmont Ave., Jersey City, N. J. This invention provides means manually operable for positively and operatively connecting the two sections of a driving shaft which is normally operatively connected through a differential gearing; and a further object is to simplify the construction of the auxiliary connecting mechanism.

BRACKET FOR VEHICLE LAMPS.—L. E. Gerrish, P. O. Box 14, East Lebanon, Maine. This invention prevents accidents by throwing the light rays right or left as the car is turned, more quickly than rays of the lights in use get around. The lamps are clamped to the arm in front or back of the knuckle by an improved vehicle bracket that will fit any car. The pneumatic tires take up any vibration that is not needed to keep the lights free from mud, as they are placed under the mud guards, one on each side. The invention is adapted to electric side lights (torpedo type) only.

FRICTION DRIVE.—C. R. Day, Arthur, W. Va. This inventor provides a drive adapted for use with automobiles and like vehicles, wherein auxiliary mechanism is provided in connection with the usual variable connection between the driving shaft and the driven shaft, for permitting the driver at will to connect the driving shaft and the driven shaft while the relative speed between the shafts is being varied.

AUTOMOBILE STARTER.—C. A. Smith, 88 Canal St., Brattleboro, Vt. The starter is especially for use in automobiles, and wherein mechanism is connected with the engine shaft for rotating the same in a forward direction, capable of being operated by the driver from his seat, without dismounting, by a movement of the foot, and so arranged that there will be no interference with the engine after it has started.

END GATE FASTENER.—T. D. Harvey, Newark, Tex. This invention provides a fastener for wagons and like vehicles and permitting a firm lock when locked, which may be readily and quickly disengaged when desired, and wherein the fastener consists of two sections, mounted for sliding movement longitudinally of each other, and having means for engagement to hold them in clamped position.

THILL COUPLING.—M. Grimord, Box 666, Iron River, Mich. This invention relates to thill couplers, and one of the principal objects thereof is to provide an improved positive acting thill coupling, which when locked is unlikely to become accidentally unlocked and which may be readily secured to a thill or shaft.

**Designs.**

DESIGN FOR A GAME BOARD.—F. J. Claveloux, 1405 F St., N.W., Washington, D. C. In this ornamental design the plan view shows a square-shaped game board, within which is an outer circle touching the edges of the square, the surface of the board being intersected with very small squares and blank spaces.

DESIGN FOR A CHILD'S RATTLE.—L. Sametz and A. R. Sametz, 430 Kent Ave., Brooklyn, N. Y., N. Y. In this ornamental design for a child's rattle, the frame of the article comprises a circular-shaped open handle, the main part of the rattle being a large ring holding five balls strung close together.

**Note.—Copies of any of these patents will be furnished by the Scientific American for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.**

## Notes for Inventors

**New Measurement Gages.**—European gages of a new type consist of a tube containing a set of steel balls such as are commonly used for ball-bearings. At the ends, part of the ball projects, so as to form the end of the gage. Such gages are claimed to be exact to 1/200 of a millimeter, owing to good workmanship. The advantages are a small end surface and hence better manipulation, perfect polish of the ends, no danger of subsequent shrinkage after tempering, greater hardness and hence longer life, also increased solidity against rough handling. Owing to the cheap, though exact production of steel balls as against accurate gages, the new method is 60 per cent cheaper than rod gages.

**Producer-Gas Locomobile.**—A French inventor, J. B. Catteau, brings out a novel locomobile which contains a veritable producer gas plant with gas engine and radiator. On the front of the chassis is a suction gas-producer fed by anthracite or various coals, being provided with a scrubber. This latter is fed from a 100-gallon tank in the car roof. At the rear of the chassis is the gas engine, with a large flywheel pulley for belt drive to any needed device. Between engine and producer is a vertical wing-tube radiator of automobile type, provided with an air fan and water pump. Economy and easy handling make such locomobiles superior to the usual steam engine types, it is claimed.

**Metallic Pump for Atomizers.**—Toilet atomizers are likely to become useless because the rubber bulb cracks. This is now remedied by a new French device in the shape of an all-metal air pump exactly on the idea of a bicycle pump, but of diminutive size. What is valuable is that it fits on to any atomizer after the old bulb is removed, and the atomizer when thus fitted is quite durable. The pump is constructed to be operated by one hand while the atomizer is held in the other.

**Folding Watch Holder.**—It is well known that watches are injured by laying them flat upon a cold metal or stone table or the like, as this causes sudden changes of temperature of the mechanism which may act to break the spring, or at least hinder the good running of the watch. Hence a suitable watchcase is recommended in which the watch is protected from such contact. We noticed a very convenient little watch support that is especially practical for travelers' use, which folds up hinge-wise and can be carried in the pocket. One part of the hinged piece lies flat on the table and the other is raised up to an angle, the watch being held in an inclined position by hooks in top and bottom piece. The time can thus be read from a good distance, and the body of the watch is free from all contact.

**New Egg-cup Device.**—This neat little Parisian device, made of aluminium or silvered metal, consists of an upturned bowl-shaped egg holder mounted on an inverted hemispherical base about as in the familiar types. In the top bowl is fitted a stopper or plug which is itself hollow and carries a perforated head so that the stopper piece serves as a salt box. Within the bowl is a detachable ring-shaped egg-cutter with inwardly projecting teeth, by which the end of the egg is neatly clipped off by a partial rotation of the cutter. When not in use the whole is packed up and thus forms a neat device.

**Flameless Powder.**—Airships equipped with machine guns run a certain degree of risk from an explosion caused by the flame at the muzzle of the gun. Hence considerable study has been devoted to obviating this danger. This has now been accomplished by a young Florentine chemist named Guido Fei, according to the *Deutsche Waffenzeitung*. He is said to have recently given a demonstration before an Italian military commission of a new powder invented by him which burns without either flame or smoke and does not flare up on detonation. Its ballistic properties are said to be excellent. While specially useful for the guns of aircraft it will be of value in artillery and infantry engagements from the fact that it will not betray the firing line to the enemy.

## Clothing a Winter Army

*(Concluded from page 215.)*

are notified where to send it; the mills are assigned to weave the cloth; in turn, the mills send their bolts to wide-scattered clothing shops where the staff has already sent patterns and specifications, and with the perfection of organization, the mill begins to grind, while the railways find means to snatch the finished product away to the depots for distribution.

Uniforms must be made, to the same number. The same principle applies, from the gathering of the raw material to the delivery of the finished article. Then, there are shoes.

Probably more attention has been given to shoeing an army than to any other detail of clothing. It is so important that the feet of the men be safeguarded in every way, for they have to march upon them, and upon marching depends the winning of battles, that countless experiments have been made to secure the most perfect fitting shoes, and from the result of these tests, the best has been adopted, an ideal. In addition to being of the greatest comfort, they must be sturdy, able to withstand to the last moment the ravages of a campaign.

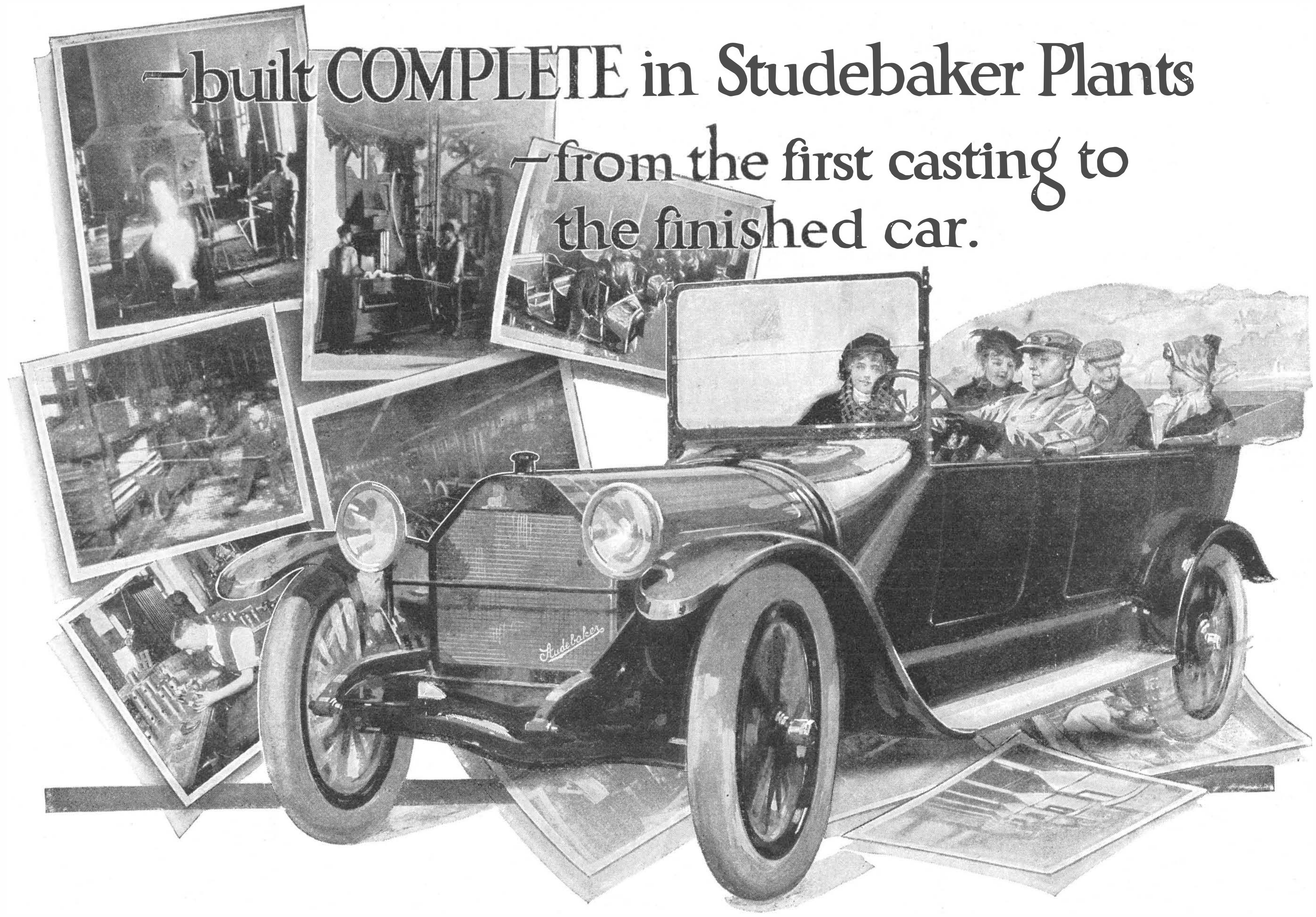
As a result of modernism, invention and organization, the American machine-made shoe has become generally recognized as the best on earth. Hundreds of thousands of American shoes were secured before the war, or American machines, upon which they could be made in the land; since the beginning of the war, millions of American shoes have been contracted for, the purchasers assuming the safe delivery of them, due to an enemy's vigilance and contraband declaration.

It is very nice for army regulations to specify the grade, quantity, and kind of underclothing. War, again, is not a nice thing, anyway it may be looked at, and very frequently one suit of underwear has had to serve, regardless of what should be. In winter time, the keeping out of cold supersedes the observation of nicety.

The Russians, for instance, rely upon sheepskin overcoats to keep out the cold. This has no bearing upon what they wear underneath, though winter-weight clothing is part and parcel of the issue, and when a war is to be of a duration which will embrace climatic changes, the outfit is for the coldest weather. Russia is a great sheep country and mutton a staple article of diet. Millions of sheep are killed there annually, and not only the army, but the peasantry rely upon the skins for warmth in winter. The problem which confronts the staff is simple, for the staff of the Czar knows where to get these skins with little trouble, so the problem of warmth is here answered. The German soldier, too, has been supplied with sheepskin winter clothing. The soldiers of France carry their winter equipment with them in summer, always ready for the field. As long as it has to be carried, it is carried by the individual in the easiest way, for even during the heat of summer the French soldier wears his overcoat unbottoned and rolled back at the skirts. There are heavier grades of uniform and underwear for the winter in times of peace, but in wartime there is but one weight—winter weight.

Of all the countries now involved in war, England has had probably the severest problem to solve with regard to clothing her men. A small standing army of 250,000 has been expanded to the neighborhood of 2,500,000. Complete uniforms must be supplied in a hurry, and the English mills have been running day and night, their output supplemented by purchase in other lands, mainly America.

Great Britain's colonial troops have come mostly from the tropics. Any man whose life has been spent in the tropics has been safeguarded by nature, which has made his blood thinner than that of a resident of a temperate or cold zone. In consequence, the cold of another clime cuts chillingly through the body, and special means are necessary to warmly clothe the tropical soldier. Heavy uniforms were prepared for the troops from India, including great coats and heavy




It's simply a matter of insurance, that's all. Insurance of the quality that a man EXPECTS in any car that carries that name of Studebaker.

Studebaker is not satisfied merely to assemble motors and axles and parts bought from parts-manufacturers, but in order to get the accuracy of fit and the balance and the harmony of operation that a car MUST have to meet Studebaker requirements, Studebaker manufactures practically all of its own parts.

And so, "—because it's a Studebaker" —because this car carries a name that for 63 years has stood for the highest ideals in manufacturing—a name that has come to be a pledge of QUALITY in every detail—Studebaker MAKES SURE by manufacturing Studebaker cars COMPLETE in Studebaker plants.

Motors, gears, axles, transmissions, bodies, tops, fenders—ALL the hundreds of parts, in fact, that go to make up a car, with the exception of the tires, the horn, the electric system and such specialized equipment as is manufactured to Studebaker specifications—are designed and manufactured in Studebaker plants.

To Studebaker, this policy of COMPLETE manufacturing means the certainty that every Studebaker car lives up to the promise of its name. And to the buyer, it means a car that carries only ONE profit—because there are no parts-makers' profits in the price—and a car that can be depended upon to give SERVICE and FULL money's worth of satisfaction for every dollar of the price

**—because it's a Studebaker**

in every detail from "stem to stern." But you will appreciate even better what this policy means to you when you RIDE in the Studebaker

## LIGHT SIX—$1385

and see the unity, the harmony that Studebaker has been able to build into this car. When you study the balance of this Studebaker-BUILT car, and its riding comfort and its ease of control. When you feel at your own finger ends that flood of power obedient to your slightest wish.

But see it—soon. Judge its beauty, its grace of design and its elegance of finish. Get the Studebaker dealer to tell you how the upkeep cost has been cut to the bone by the same policy of COMPLETE manufacturing. And today, write for "The Story of Studebaker"—a handsomely illustrated book that tells in detail how the Studebaker is built.

**STUDEBAKER—DETROIT** **Canadian Factories, Walkerville, Ont.**

*Studebaker Features*

Electric Lighting and Starting—Full Floating Rear Axle—Timken Bearings—Safety Tread Rear Tires—One-man Type Top.

| | Price in U.S.A. | Price in Canada |
|---|---|---|
| Studebaker ROADSTER, . | $ 985 | $1250 |
| Studebaker FOUR, . . . . | 985 | 1250 |
| Studebaker LIGHT SIX, . . | 1385 | 1750 |
| Studebaker SIX (7-passenger), | 1450 | 1825 |

F.O.B. Detroit

blankets, and observers report that the Indian forces irked severely at the additional binding and weight of the heavy clothing at first, only to hug it with delight when the cold set in.

There is a great difference between the method of clothing supply in the United States army and any foreign army. In the first case a certain annual monetary allowance is made for clothing, which the soldier may draw in such proportion of clothing as he needs. For instance, if one man is harder on shoes than on breeches, he may receive or draw more shoes. Another man may have a special knack for getting wear out of shoes and none out of breeches. He may draw either so long as his clothing fund lasts, and the clothing all belongs to him. But in the foreign armies, the clothing belongs to the government, every piece, and as it is worn out, new is issued to the soldier.

When this Utopian army takes the field, 4,000,000 strong, it will be fully equipped. Assuming that the war will last a year, it will be necessary to renew the clothing at least three or four times.

A prodigious amount of clothing! Four to eight million blankets, for these constitute the bedding in the field. Sixteen to twenty million uniforms, blouses, breeches, headgear, shoes, underwear, shirts, etc., with at least six to eight million overcoats. Statisticians may easily figure out the number of thousand mile strips of material involved in their manufacture. And the delivery of the clothing to the combatant forces falls upon the overworked line of communication service, through the entire zone. Additional arrangements are necessary to supplement the daily shipments of food, forage, and ammunition to the line by rail and motor truck of the supply columns. It is thus evident how every part of the military machine hangs upon some other part—how the whole may not operate unless the parts function properly.

This brings the matter back to where it started—the staff. The General Staff is at the bottom of it all, for it has the duty of working it all out. The answer to the question goes back to the often repeated axiom: "In time of peace prepare for war."

## The Flying Machines of the Warring Powers

(*Concluded from page 227.*)

war, with the exception of Russia, cannot supply machines to the army fast enough.

### Russia's Enviable Position.

Russia is in the enviable position of having a large surplus of aeroplanes as she possessed at the beginning of August over four hundred machines and about two hundred pilots. The principal types are the Albatros, Aviatik and Rumpler, the Bristol, and the Deperdussin, Farman, and Nieuport. The majority were constructed under license in Russia. The only important machine of Russian design is the Sikorsky biplane, made in moderate sizes as well as in its huge form.

The various powers have appreciated the importance of repairs in the field and all have well equipped automobile workshops. The problem of supplying spare parts has also received careful consideration, and here again the automobile comes into play. Particular attention has been paid to the problem of aeroplane transport by road or rail. In tractor biplanes the plane sections on either side of the fuselage and central cellule are quickly detachable. Indeed a few models have folding wings. With monoplanes the wings are easily detached. Some of the smaller machines of this type can be transported by motor truck when the wings are detached, but generally speaking the fuselage is towed along the roads.

Very little reliable information has been obtainable in regard to the types of machines the French factories are now producing. It is a known fact, however, that the Blériot factory at Buc has been requisitioned by the government for the production of the marvelous little Caudron biplanes. The reason given for the refusal of the government to take any more Blériot machines is their rather poor

## LEGAL NOTICES



## Classified Advertisements



## INQUIRY COLUMN

READ THIS COLUMN CAREFULLY. You will find inquiries for certain classes of articles numbered in consecutive order. If you manufacture these goods write us at once and we will send you the name and address of the party desiring the information. There is no charge for this service. *In every case it is necessary to give the number of the inquiry.* Where manufacturers do not respond promptly the inquiry *may* be repeated.

MUNN & Co., INC.

*Inquiry No. 9419.* Wanted a material to take the place of celluloid or gelatine to be used as a window on boats, carriages and automobiles. It must be transparent enough to afford a good view and must be capable of being folded or rumpled without injury and must be waterproof.

*Inquiry No. 9420.* Wanted the name of a concern who can make a glass jar.

*Inquiry No. 9421.* Wanted to find a manufacturer who can turn out scissors in thousand lots. Special design. Full particulars on application.

*Inquiry No. 9422.* Wanted the name and address of a manufacturer of a machine which can crack Japanese walnuts whole.

*Inquiry No. 9423.* Wanted the name and address of a concern that manufactures a product which is light in weight also pliable to the tensity of spring steel in flexibility. The material is wanted in strips varying from ¼ to ¾ of an inch in width and from 4 to 8 inches long and 3-32 to 1-16 of an inch in thickness. Vulcanized rubber would answer the purpose provided it could be made to bend.

*Inquiry No. 9424.* Wanted the name and address of a manufacturer who can supply paper twine and what is known as cardboard strip.

*Inquiry No. 9425.* Wanted the name and address of a manufacturer of supplies for model aeroplane and boat builders.

*Inquiry No. 9426.* Wanted the name and address of a manufacturer who can make ⅝" buoyant balls made into perfect spheres in large quantities. They are intended to take the place of cork. Possible wood pulp might be used.

*Inquiry No. 9427.* Wanted to secure patented device which is practical, not too expensive, and for which there is a real demand.

*Inquiry No. 9428.* Wanted to secure an interest in a manufacturing concern. Will buy part or entire interest. Must be a going concern.

*Inquiry No. 9429.* Wanted the name and address of a manufacturer of a machine for bleaching beeswax.

*Inquiry No. 9430.* Wanted the name and address of a manufacturer who can supply machinery for producing soluble coffee.

*Inquiry No. 9431.* Wanted to purchase a mold for shaping and piercing beads made of rose leaf of the consistency of dough.

*Inquiry No. 9432.* Wanted the name and address of a manufacturer of watch glasses 9 inches in diameter.

*Inquiry No. 9433.* Wanted the name and address of a manufacturer of a material such as is used by gas mantle makers. The material is used to cover the wire frame that supports the mantle at the top and is used to protect the wire from the flame or heat of the mantle.

*Inquiry No. 9434.* Wanted the name and address of a manufacturer of special pins, 1/16 of an inch in diameter and ¾ of an inch long, the pins to be made of bone.

climbing qualities, notwithstanding the fact that Blériot brought out a new model supposed to be an improvement in this respect. Up to the outbreak of war the Morane machines were built by Liore and Olivier and then sold to the Morane-Saulnier firm. Better arrangements have certainly now been made for the production of this machine.

The British government has ordered seven replicas of the "America" from the Curtiss Aeroplane Company. Large orders from abroad are also being filled for Sperry gyroscopic stabilizers. It would seem, therefore, that the American aviation industry may soon come in for its share of prosperity at last.

### A New Casing for Sausages*

**By W. P. Cohoe, E. C. Fox, and A. J. Acton**

CASINGS for sausage meats at present in use consist of the larger intestines of the ox, sheep, and hog, known in the trade as bungs; the gullet of the ox known as "Weasands," and the smaller and middle intestines of the ox. For small sausages the smaller intestines of the sheep and hog are used.

No exception can be taken to them providing proper precautions are taken to insure their purity. In the large packing houses the conditions of purity are more closely watched than in small butcher shops and abattoirs, but a sanitary substitute is highly desirable.

An ideal casing should possess the following properties:

The raw material should be pure and uniform. The process of manufacture should not permit any possibility of contamination by disease germs. The finished product should be of uniform chemical composition. It should be mechanically suitable. It should have a pleasing physical appearance. It should not provide a surface upon which mold and other organisms can readily propagate. It should not contain substances injurious to the human organism. It should be, although in many cases not necessarily so, edible. If possible it should be digestible. It should be capable of being kept, stored, and transported, under ordinary conditions, for an indefinite period of time, without deterioration.

In order to find a substitute for the present casings, a survey of the field of possible raw materials was made, and it was finally decided to try cellulose (hydrate) and to use the viscose reaction of Cross and Bevan.

Bleached sulphite wood pulp is used as the raw material. This is mercerized by the action of caustic soda solution, washed and treated by carbon disulphide.

On the addition of water swelling takes place, giving a thick viscous solution without a trace of fibrous structure. This material is then manufactured into tubes, and passed into a salt solution, which converts it into a yellow jelly. The byproducts of the reaction are largely removed by washing in mixed solutions of sodium sulphides and bisulphites. Many of the salts may be removed by heat, either by the direct action of steam, or by passing the tube through a hot solution, either of salts, alcohol, glycerin, and many other substances.

The tube, which now consists of cellulose (hydrate) together with adhering sodium salts, is washed thoroughly in boiling water. The length of time necessary to accomplish this may be first determined by an ash determination. When the amount of ash falls to an amount equal to that in the original bleached sulphite pulp, freedom from impurities is assured. The tube is finally dried, conditions, and rolled up ready for shipment.

Should colorless product be desired, the tube may be bleached after the hot wash. In this case it is led first through a hypochlorite solution, then washed in water, then led through thiosulphate solution, and finally washed in water.

Bleached sulphite pulp is pure, abundant and uniform. The chemical treatment it undergoes insures an aseptic con-

* Read before the Canadian Section of the Society of Chemical Industry, and condensed from the *Journal*.

dition. Inorganic impurities are limited to the small proportion of ash, 0.50 per cent mainly, consisting of alkalis and alkaline earths.

The experience in Canada with the use of the new product showed that its mechanical properties were satisfactory. Although the origin of the casing was known to the store managers, yet the man behind the counter, who had been handling sausages for years, did not recognize the change of material.

Cellulose (hydrate) casings are transparent and colorless in thin films when unbleached, and when bleached are colorless in all usual thickness. The surface is smooth and glossy, and does not easily afford a lodging place for mold or bacteria.

Taking the mean content of 1.8 per cent of cellulose in American wheat, obtained by Richardson, after 407 analyses (Am. 6,302) and remembering that the casing of a sausage is from 1.04 to 1.12 per cent of its total weight, it will be seen that the eating of many of the prepared breakfast foods made from whole wheat, e. g., shredded wheat biscuit, involves a larger percentage of cellulose than does the eating of a sausage with cellulose (hydrate) casing.

Furthermore, it can be shown that cellulose (hydrate) is in a form more susceptible of chemical attack than is the hard covering of the cereal grains.

Edibility is demanded only in the case of small sausages, the casings of which consist of intestines of the sheep or hog. The casings of sausages of the Bologna variety cannot be masticated in any reasonable length of time, and are simply coverings or food containers. The meat of the sausage also does not adhere to the casing as it does to the old ones. A Bologna casing made of cellulose (hydrate) can, however, be masticated. In such a case, a soft non-irritant mass is produced. In the case of the smaller sausages, the thickness of the casing is very small (0.004 to 0.006 inch).

### Activities of the American Museum of Natural History

IN his annual report President Osborn stated that the Museum had made explorations in three continents during the past year, and still had twenty-nine expeditions in the field.

The museum is conducting an expedition in the Arctic regions, two in South America and three in Africa. The Congo expedition has gathered its collections, amounting to forty-five tons, at Stanleyville, and is sending it down the river for transportation to New York. For three years extensive field operations have been carried on in South Africa, other expeditions have been sent to Colombia, Brazil, and Paraguay, while an expedition to study volcanoes is leaving for the West Indies.

More than 5,000 specimens collected by the Roosevelt expedition to Paraguay and Brazil have been received, as well as the Schrammen collection of over 5,000 fossils. A collection of 265 sharks and other fishes from Japan has been added and the collection of Peruvian pottery from Nasca, Perú, comprising about four hundred pieces, is now on exhibition. Another addition is the Howell collection of meteorites.

Attention is called to the need of money to carry on the work of the museum as the municipal appropriation has been decreased and the entire income, with the exception of restricted amounts, is required for maintenance.

**Toothbrush Without Handle.**—The rubber toothbrush is a familiar article at present, but a European inventor recently had the idea to dispense with the usual handle and to make a small and convenient article by forming the rubber brush in the shape of a glove-finger, which is studded with the usual projecting points. This is much more convenient to use than a toothbrush of the ordinary kind because the finger can explore all parts of the mouth, and the operation is carried out more easily by the finger than by the use of a stiff handle. Its small size and no doubt low price is also a recommendation.

## Notes and Queries

Kindly keep your queries on separate sheets of paper when corresponding about such matters as patents, subscriptions, books, etc. This will greatly facilitate answering your questions, as in many cases they have to be referred to experts. The full name and address should be given on every sheet. No attention will be paid to unsigned queries. Full hints to correspondents are printed from time to time and will be mailed on request.

(13041) W. J. R. asks: Will you please inform me through the medium of your paper or otherwise of the visibility of anything under water with respect to an aeroplane? How far can they see into the water, and can they, as they go higher to certain limits, see farther or deeper? Did they find the British submarine, which was sunk during January last, as has been stated, at a depth of 200 feet? A. We have consulted a naval aeronautic expert on the visibility of submarines from an aeroplane. He states that if the surface of the water is smooth, and the water is fairly clear, a submarine can ordinarily be observed visually from an aeroplane at any depth the submarine is likely to travel, which is usually not over 100 feet. Experiments have been made at Guantanamo, Cuba, and Annapolis, Maryland, and in the latter case the submarines were able to avoid observation at first by sinking to a muddy bottom. But the aviators soon learned to pick them out by some sign, such, for example, as escape of air bubbles. The British have hitherto made no provision for carrying aeroplanes and launching them from cruisers or dreadnoughts far from a base, and this is doubtless one reason why more has not been done by the British aeroplanes in operating on the German fleet. We have no information regarding the finding of the submarine in question. Vision below the surface is doubtless not improved by rising to a great height above the surface.

(13042) O'R. & H. asks: Why is the proportion of $CO^2$ in the atmosphere practically constant in all seasons of the year? $CO^2$ is being constantly produced by the exhalation of animals and by volcanic action, etc. Plant life absorbs carbon dioxide, breaks it up, stores up the carbon and gives off the oxygen. Most books cite this explanation for the fact that $CO^2$ remains practically constant in proportion in the atmosphere. As far as we have been able to determine, the books and authorities do not seem to take into consideration the fact that vegetation lies dormant during the winter season and necessarily cannot absorb as much $CO^2$ as in the summer time. How, then, is this excess of carbon dioxide produced during the winter season taken care of? A. We have never seen any discussion of the point you raise in reference to the invariability of the amount of carbon dioxide in the atmosphere. It is found to be about 0.0003 per cent, or 3 parts in 10,000 parts of air by weight, in all places where the air is reasonably pure. In many places there is more than this. We should explain the matter by saying that this small proportion is still so enormous a quantity that the adding or subtracting what animals supply in a winter when plants are not drawing upon the supply does not affect the grand total. It is like bailing water from the ocean, yet is the ocean full. Then again, plant growth does not cease over the largest zone of the earth, the Torrid, all the year through. The weight of the air is five sextillion tons; or 5 followed by 15 ciphers. The carbon dioxide weighs about 1.5 followed by 12 ciphers. This quantity is inconceivably enormous, and may well be considered invariable by any power of men, animals and plants.

(13043) H. W. M. asks: I am interested in the matter of lightning arresters as used on modern telephones. What are the best references on this matter? What is the prevailing opinion on the matter? Is lightning arrester a misnomer? Will they really offer any protection from lightning discharges? Might a discharge take place, such as to harm a person, without doing any harm to the instrument itself? A. Lightning arresters are by no means a misnomer. They act to cause the electricity to pass to the earth, across the gap of the arrester. Every transmission line and every telephone or telegraph line is probably protected, so that the instruments are rarely burned out in a thunder storm. A discharge might take place which would do harm when there is an arrester; but most lightning flashes can be carried by the arresters now employed. It is good policy to protect against the sort of discharges which can be handled, although there may be some which cannot be controlled. The best references are to the electric companies which have long transmission lines over the country where electric storms are frequent, as in the mountains of the west, or from Niagara Falls to the east and west; or to the Western Union Telegraph Company, and the Bell Telephone Company.

(13044) R. W. asks: 1. What is the principle on which the chemical weather glasses work? Crystallization of the mixture is supposed to indicate falling weather. The tubes are sealed so that pressure of the air or humidity could not be communicated to the contents. A. The so-called chemical weather glass contains camphor dissolved in alcohol. A very slight change in temperature changes the amount of camphor which can be held in solution by the alcohol. Humidity and the pressure of the atmosphere have no influence upon its condition. 2. The molecules or atoms of any substance are supposed to be in a state of very rapid vibration. If this were the case, would not there be some friction and the constant production of heat? A. In the

production of heat by collision, both weight and velocity of the moving weight are involved. The weight of a molecule is so small that no appreciable amount of heat could be evolved in a very long time. An infinitesimal weight would require an infinite time at a finite velocity to produce any small change of temperature in ponderable matter. 3. What is the nature of the magnetic flux that is supposed to circulate in a magnet? A. The magnetic flux consists of imaginary lines of force, or the lines along which a magnet pole would be urged by the magnetic force. They are hypothetical lines only, but are suggested by the fact that iron filings arrange themselves in lines under the action of the force of a magnet, covering some spaces and leaving other spaces bare of filings.

(13045) P. J. P. asks: Could the steamship "Titanic" reach bottom, no matter what the depth? A. Anything which will sink in water at the surface will sink to the bottom anywhere, in the deepest place in the ocean or along the shore. This is because water is nearly incompressible, and a cubic foot of water at the bottom of the deepest place in the ocean weighs only about one-twentieth more than at the surface. The difficulty in this matter arises from confusing pressure with weight. A body sinks in water when it weighs more than the same volume of water weighs. A cubic foot of fresh water weighs 62.4 pounds. Anything which weighs more than this will sink in fresh water. Salt water weighs about 64 pounds per cubic foot on the surface, although this varies somewhat in different parts of the ocean. At the bottom it weighs only 3½ pounds more than at the surface. Steel weighs 7.7 times as much as water, hence the ill-fated "Titanic" went to the bottom with a great velocity when her compartments were burst in by the pressure of the water. This took place as she went down, according to the reports of the explosions heard, and the water filled her completely. There was then little to prevent her from sinking, only the woodwork and the bodies of the dead. All this was carried down to the bottom of the ocean. Calculation shows that she probably struck with a high velocity. Pressure does not prevent motion. We are under a pressure of 15 pounds per square inch, or more than a ton per square foot, by the air which surrounds us, but we fall with great velocity, or move about through the air with ease. It is the same with water pressure. When a diver goes down 100 feet, he is under a pressure of nearly 4½ tons per square foot, but he can still move around.

This question has been asked so many times lately that we give it space again. You will find a number of articles in the SCIENTIFIC AMERICAN at the time of the "Titanic" disaster. One editorial, which covered the subject, appeared in Vol. 106, No. 17, which we will send for ten cents.

(13046) C. L. V. asks: Will you kindly tell me what preparation or chemical solution I can use to make wood burn with a blue or other colored flame for use in a fireplace? A. Artificial drift wood, which burns with a greenish or blue flame like the wood from an old wreck, may be made by soaking pieces of soft wood, white pine or white wood, in a strong solution of copper chloride in water and drying the wood. A pound of copper chloride will serve to prepare a large quantity of wood. The best way to proceed is to set the pieces of wood, split as for kindling, end wise in a wooden, or better, an agate pail. The solution will soak into the wood better if the upper ends of the sticks are out of the water and dry. Do not use an iron pail because it will be ruined by corrosion from the solution. The addition of an ounce of lithium or strontium chloride will give red flashes in the flame.

(13047) D. B. writes: In your issue of December 19th, 1914, I notice an answer to Mr. L. A. DeBois's letter, which appeared in your War Issue No. 3, regarding lightning and the automobile, by Mr. C. Langley Johnson of Santiago de Cuba. Mr. Johnson ends his article doubting if ever anyone had been struck by lightning in an automobile. In answer will say I read in a Spokane, Wash., daily last fall where two couples were riding in an automobile, the two men seated in the front seat were struck by lightning, killing them instantly, yet the chauffeur clung to the steering wheel in a limp position, running from side to side of road till the car ran over an embankment, injuring the women, but the men were dead from the shock. A. The position taken by Mr. Langley C. Johnson in the letter referred to seems to us a sound position, that the rubber tires offer some degree of protection from lightning. He says they do not offer enough to protect from a direct lightning flash, but might influence a discharge to save a life which otherwise might be taken. That an instance has occurred in which life has been taken does not break the force of this argument. We think persons in an automobile would be quite safe if the cover had metal bows and was up over their heads. Still there is no absolute safety from a lightning stroke excepting in an iron box or cage or entirely below the surface of the earth.

(13048) A. H. B. reports a Leclanché wet battery which has served to ring a door bell for over twenty-one years. It was put in in December, 1893, and is still doing good service. It is of the carbon cylinder type with the zinc hanging in the center. The cell is paraffined and the top closes the joint, so that the evaporation can only take place around the zinc. The report is that no zinc, water, nor sal ammoniac has been added in all these years. There is now about an inch of the solution remaining in the jar. The slowness of the evaporation can be accounted for by the closeness of the joints at the top of the jar. There is the usual alum crystallization in the bottom of the cell. The amount of service called for each day is not stated. But under any conditions of service the battery is perhaps the oldest on record and goes to show the superiority of a well made wet cell over the ordinary dry cell.

## NEW BOOKS, ETC.

HEATON'S ANNUAL. The Commercial Handbook of Canada and Boards of Trade Register. 1915. Toronto: Heaton's Agency. 8vo.; 442 pp. Price, $1 net.

Now in its eleventh year, Heaton's Annual has become an almost indispensable desk book for business men who in any way come into relation with the Dominion. The Canadian customs tariff and regulations is one of the important subjects comprehensively handled There is much encyclopedic information with references to government publications for details. Every commercially important town is briefly described, as are also those agricultural districts toward which immigration is directed. The industries and opportunities of the country are listed, so that manufacturers desirous of establishing a Canadian branch may be reliably guided in their decision as to locality. A new feature of the Annual is "Where To Find It," which is really an economic bibliography of government reports and standard publications.

THE NATIONS AT WAR. The Birth of a New Era. By L. Cecil Jane. New York: E. P. Dutton & Co. 12mo.; 228 pp. Price, $1 net.

In this series of papers Mr. Jane reaches rather extreme conclusions. There is much sound, not to say shrewd, observation upon such subjects as athleticism, feminism and religion, though the treatment errs upon the side of the academic. The author takes for granted the success of the Allies. While admitting that they will reorganize the Continent in their own interests, he adds that their interest is assuredly the interest of all other states, large and small. He commits himself to the opinion that the end of the war will usher in a lasting, universal peace; he bases this opinion mainly upon the titanic nature of the conflict. "Men are moved by nothing more readily than by the immense." This sense of immensity is to change Nature itself. In this conclusion optimism would seem to part company with common sense. Even should the victory of the victorious prove sweepingly complete—which is unlikely—neither history nor observation warrants us in expecting human nature to change in any abrupt or radical way.

THE DAILY NEWS ALMANAC AND YEARBOOK FOR 1915. Compiled by James Langland, M.A. Chicago: The Chicago Daily News Company. 8vo.; 727 pp.

BROOKLYN DAILY EAGLE ALMANAC. 1915. Brooklyn, New York: Eagle Building. 8vo.; 608 pp. Price, $1.

The word "almanac" has of late years been stretched to cover annual encyclopedias containing astonishing amounts of condensed information the distinguishing feature of which is the world's progress for the year. Two such annuals are the Daily News Almanac and the Eagle Almanac, issued by two of the great newspapers of the country. The alertness of the compilers, and their zeal in bringing their work down to date, is evidenced by the inclusion in the latter volume of the Italian earthquake of January 13th, 1915. This book has some useful maps supplementing its specialty of presenting most fully New York city and Long Island interests. These show a wealth of useful detail. The Daily News Almanac has, among other countless features of appeal, the text of the various white, yellow and orange books issued by the nations at war. Both volumes devote much space to war facts and statistics, and both of course carry the innumerable tables and compilations dealing with our national activities, from athletics to government and religion.

THE AMERICAN WHITAKER ALMANAC AND ENCYCLOPEDIA FOR 1915. C. W. Whitaker, M.A., F.S.A., Editor. New York: Doubleday, Page & Co. 8vo.; 648 pp.

The American Whitaker first gives us a fund of astronomical and weather lore, as befits its primary purpose. Our government, immigration, population, the growth of our cities, our paupers and insane, our societies, institutions and colleges, banking and finance, and crop production is all presented in the briefest way consistent with accuracy. The states, territories and dependencies of the United States are dealt with at large, and there is more condensed information concerning foreign powers. In the war section is a long summary of the great war, covering both the land engagements and naval operations during 1914. There is a full index of the 9,000 facts presented, which renders any desired information readily accessible.

CHARACTER READING THROUGH ANALYSIS OF THE FEATURES. By Gerald Elton Fosbroke. New York: G. P. Putnam's Sons, 1914. 8vo.; 193 pp.; 56 illustrations from original drawings by Carl Bohnen. Price, $2.50 net.

Of late, physiognomy has been put forward as an art that could be of inestimable service in the realm of business and industry. Mr. Fosbroke has collated much theory in regard to the relationship of features and traits, with the invaluable assistance of an artist who has entered thoroughly into the spirit of the investigation. The features are separately examined, and conclusions drawn from many lives. The various temperaments receive careful consideration, and the uses to which physiognomy may be put are briefly sketched. The author's claims are generally conservative; and we would add the caution that analysis should be only a conscious step toward synthesis. For this reason the intuitional reader of character is always superior to one who, without natural aptitude, bases his conclusions upon separate features or largely upon a combination of several. It is a case where a combination is not only greater than any of its parts; it is greater than all of them.

SALE OF BACK NUMBERS OF THE

# Scientific American Supplement

## TO BE DISCONTINUED

*Of Importance to Librarians*

The Scientific American Supplement is a unique periodical.

Established in 1876 to describe the exhibits of the Philadelphia International Exposition, it proved so successful that the publishers decided to continue it on broader lines.

Whenever a Tyndall, a Huxley, a Helmholtz, a Pasteur, a Liebig, a Crookes or any other prince of science rose in the learned societies of Europe and announced some new epoch-making discovery of his, his own words appeared in the Scientific American Supplement. The technical papers read by engineers before societies in America—papers too recondite and too long for more popular periodicals —have been given a place in the Scientific American Supplement. Americans who could not read foreign languages found in the pages of the Scientific American Supplement the utterances of great European physicists and chemists translated into English.

So, in the course of time, the Scientific American Supplement has become a kind of encyclopedia of scientific information. It figures over and over again in the footnotes to monographs and scientific treatises; it has played its part in research of all kinds.

As remarkable as the publication itself is the method by which it has been made accessible to the general public. **Every number of the Scientific American Supplement from 1876 to 1915 is kept in print. What is more, the numbers of 1876 are sold for 10 cents just as if they were published today.** And this despite the fact that publishers of newspapers and periodicals often charge several hundred per cent more for back numbers than for new ones.

The Scientific American Supplement will continue to print the papers of great scientists and engineers as it has in the past. **But the policy of reprinting back numbers will be discontinued.**

For a few weeks only we shall be able to furnish all the single numbers of the Scientific American Supplement or bound volumes.

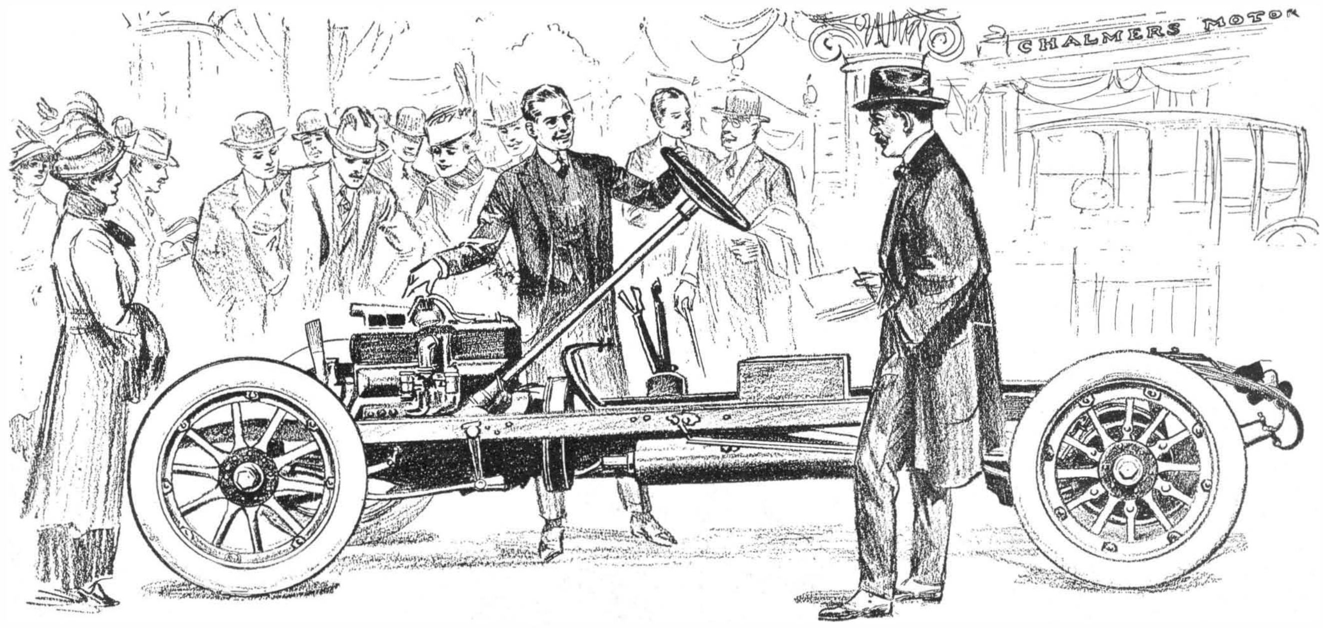
**This announcement is made for the benefit of libraries in which complete sets of the Scientific American Supplement are not to be found, and for those interested in science who feel a genuine need for an encyclopedia of science of the most diversified kind.**

We will also supply, free of charge, on request, copies of the Scientific American Supplement Catalogue, in which all the papers that have been printed in the Supplement since 1876 are indexed. This catalogue will not be published in the future.

*Order back numbers or bound volumes of the Scientific American Supplement now either from your bookseller or directly from the publishers.*

*Order Bound Volumes of the Scientific American Supplement Now*

MUNN & CO., Inc., Publishers : : : : : 361 Broadway, New York




Quality First

# Why the Chalmers is the Lowest Priced "Six"

Quality First

## Don't Judge by the Purchase Price

What you pay when you buy a car is not the *real* price.

The *real price* is what you pay *while you have it*—the upkeep cost for service.

The car of expensive upkeep cost is the *high-priced* car.

Figured this way, the economical Chalmers Light Six-48—now $1650—is the *lowest priced* "Six."

For its cost of service—season after season—is lowest.

So the Chalmers $1650 Light Six-48 has won the preference of practical men everywhere.

It is the fastest selling "Six" Chalmers has yet built.

## Where the Chalmers Excels in Economy

Quite possibly there are other "light sixes" that consume no more gasoline in a season.

But gasoline saving is comparatively a minor saving.

$25 will easily cover the difference between the season's gasoline costs of any two "light sixes" on the market.

It isn't in oil, either, that the Chalmers Light Six-48 is so much more economical.

But oil cost is a very small part of upkeep expense. A gallon will last for hundreds of miles.

It is really the repair bill that determines whether the upkeep cost of any car is high or low.

One repair bill is often large enough to wipe out a season's saving in oil and gasoline.

Right here—in this matter of repairs—is where the Chalmers Light Six-48 makes a greater saving than any other "light six."

## No Other Car "Stays Put" Like the Chalmers

No other "light six" is so well built to stand hard service.

The test of the past season has shown that this car excels all others in meeting severest usage without a single part flinching.

Most cars will run well the first month. It's in the second and third and later months that the real ordeal comes.

It is then the Chalmers Light Six-48 begins to show its marked superiority—its greater strength and stamina.

## Why the Chalmers "Stays Put"

Four qualities are mainly responsible. First,—its *construction is right.* The basic principles of its design are correct. Strains and stresses have been eliminated.

Second,—its *weight is right.* Not too light, for an underweight car is necessarily flimsy. Nor yet is it too heavy.

Third,—it has *proper balance.* The load is distributed properly. The rear axle carries just the right amount. The front axle is not overburdened. Moving parts are adjusted with hair's breadth accuracy.

Fourth,—the *materials* put into this car are of top-most quality. Makers of steel and automobile accessories will tell you that no company is more exacting in its requirements.

## What the Chalmers Saves You

It saves you in first cost—considering its value. For it is a manufactured car. Parts makers' profits do not swell the purchase price.

Rigid economy in building operations has cut costs here to the lowest notch. You save, too, in daily, monthly cost.

For this car's service, season after season you pay less than the owner of any other "light six."

And these economies have been proved this season by over 4000 owners.

Go today and see this car of economy at the nearest Chalmers dealer's.

***Send for our "Economy" booklet***

**Chalmers Motor Company, Detroit**


# It Sets the Pace

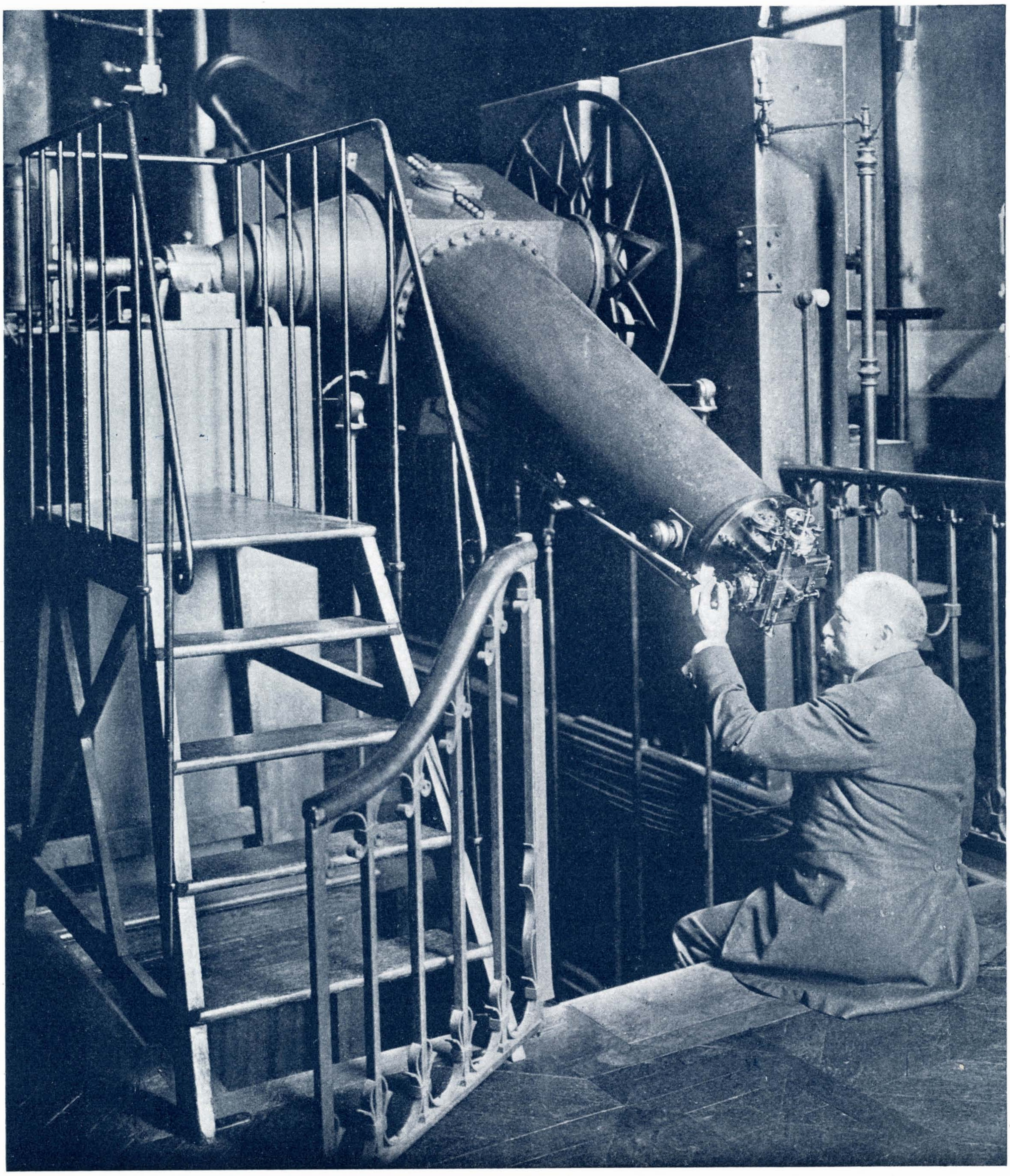
**Oldsmobile**

Established 1880 Incorporated 1899

OLDS MOTOR WORKS

LANSING - - MICHIGAN

# SCIENTIFIC AMERICAN



THE LARGE TRANSIT CIRCLE AT THE PARIS OBSERVATORY, NOW USED ONLY FOR OBTAINING ACCURATE TIME.—[See page 251.]

Vol. CXII. No. 11
March 13, 1915

Munn & Co., Inc., Publishers
New York, N. Y.

Price 10 Cents
$3.00 A Year

## REPRINTING
OF THE
# Scientific American Supplement
## TO BE DISCONTINUED

The Scientific American Supplement is a unique periodical.

Established in 1876 to describe the exhibits of the Philadelphia International Exposition, it proved so successful that the publishers decided to continue on broader lines.

Whenever a Tyndall, a Huxley, a Helmholtz, a Pasteur, a Liebig, a Crookes or any other prince of science rose in the learned societies of Europe and announced some new epoch-making discovery of his, his own words appeared in the Scientific American Supplement. The technical papers read by engineers before societies in America—papers too recondite and too long for more popular periodicals—have been given a place in the Scientific American Supplement. Americans who could not read foreign languages found in the pages of the Scientific American Supplement, the utterances of great European physicists and chemists translated into English.

So, in the course of time, the Scientific American Supplement has become a kind of encyclopedia of original scientific sources. It figures over and over again in the footnotes to monographs and scientific treatises; it has played its part in research of all kinds.

As remarkable as the publication itself is the method by which it has been made accessible to the general public. **Every number of the Scientific American Supplement from 1876 to 1915 has been kept in print. What is more, the numbers of 1876 have been sold for 10 cents just as if they were published today.** And this despite the fact that publishers of newspapers and periodicals often charge several hundred per cent more for back numbers than for new ones.

The Scientific American Supplement will continue to print the papers of great scientists and engineers as it has in the past. **But the policy of reprinting back numbers will be discontinued.**

For a few weeks only we shall be able to furnish all the single numbers of the Scientific American Supplement or bound volumes.

This announcement is made for the benefit of libraries in which complete sets of the Scientific American Supplement are not to be found, and for those interested in science who feel a genuine need for an encyclopedia of science of the most diversified kind.

We will also supply, free of charge, on request with any order, copies of the Scientific American Supplement Catalogue, in which all the papers that have been printed in the Supplement since 1876 are indexed. This catalogue will not be published in the future.

*Order back numbers or bound volumes of the Scientific American Supplement now either from your bookseller or directly from the publishers.*

**MUNN & CO., Inc., *Publishers,* 233 Broadway, New York**

SEVENTY-FIRST YEAR

SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

VOLUME CXII. NUMBER 11. NEW YORK, MARCH 13, 1915 10 CENTS A COPY $3.00 A YEAR

## Panama Canal Open to Large Ocean Liners

THAT the recent heavy slides in the Culebra cut have not by any means stopped the traffic of ocean-going ships is proved by the accompanying illustration, which shows the "Kroonland," of 22,000 tons displacement, the largest ship which has navigated the canal, passing through Culebra cut at a point opposite the troublesome Cucaracha slide.

It will be remembered that the last movement of this slide was so serious that the material practically cut off all navigation. That the channel has been opened sufficiently for such a large ship as the "Kroonland," which is nearly 600 feet in length, to pass through, is due to the very powerful dredging machinery which was ordered by Col. Goethals about two years ago for this very kind of work. The two huge dipper dredges of the Gamboa type, aided by ladder dredges and hydraulic dredges, have made such rapid inroads on the slide that when the "Kroonland" passed through, the canal presented to the eye a normal condition. That there will be other slides is probable; but they will decrease in size and number as the days pass by, and the time is probably not far distant when the banks of the great Culebra cut, which is nine miles in length, will on both sides have found a slope of permanent repose.

According to the last statement from the Navy Department, the fleet will not be sent through the canal, but will probably content itself with entering Gatun Lake and taking part in a review in those waters. We think that this is a wise course; for if the ships did pass through to the Pacific side, and a slide of magnitude occurred, they might find themselves under the necessity of passing around Cape Horn in order to make sure passage back to Atlantic waters. In view of the present disturbed condition in Europe, and the many diplomatic questions of international scope which are arising day by day, this condition of affairs would certainly be deplorable.

## The First National Bird Census

THE much-talked-of "census of the birds" taken last summer by the U. S. Biological Survey undoubtedly led to popular misconceptions as to the purpose and scope of this novel undertaking; hence, there was ample need for Bulletin 187 of the Department of Agriculture, just issued, entitled "Preliminary Census of Birds of the United States," in which the subject is put in its proper light.

The first extensive undertaking of similar character in this country, but on a local, not a national, scale, was the "sectional bird census" taken at Berwyn, Pa., during the seasons of 1899, 1900, and 1901, by F. L. Burns. In that case 588 pairs of native birds were found breeding on 640 acres. In the summer of 1907 the University of Illinois conducted a series of statistical bird studies in southern Illinois. A bird census of a tract of land near Washington, D. C., has been taken annually for some years by the Biological Survey.

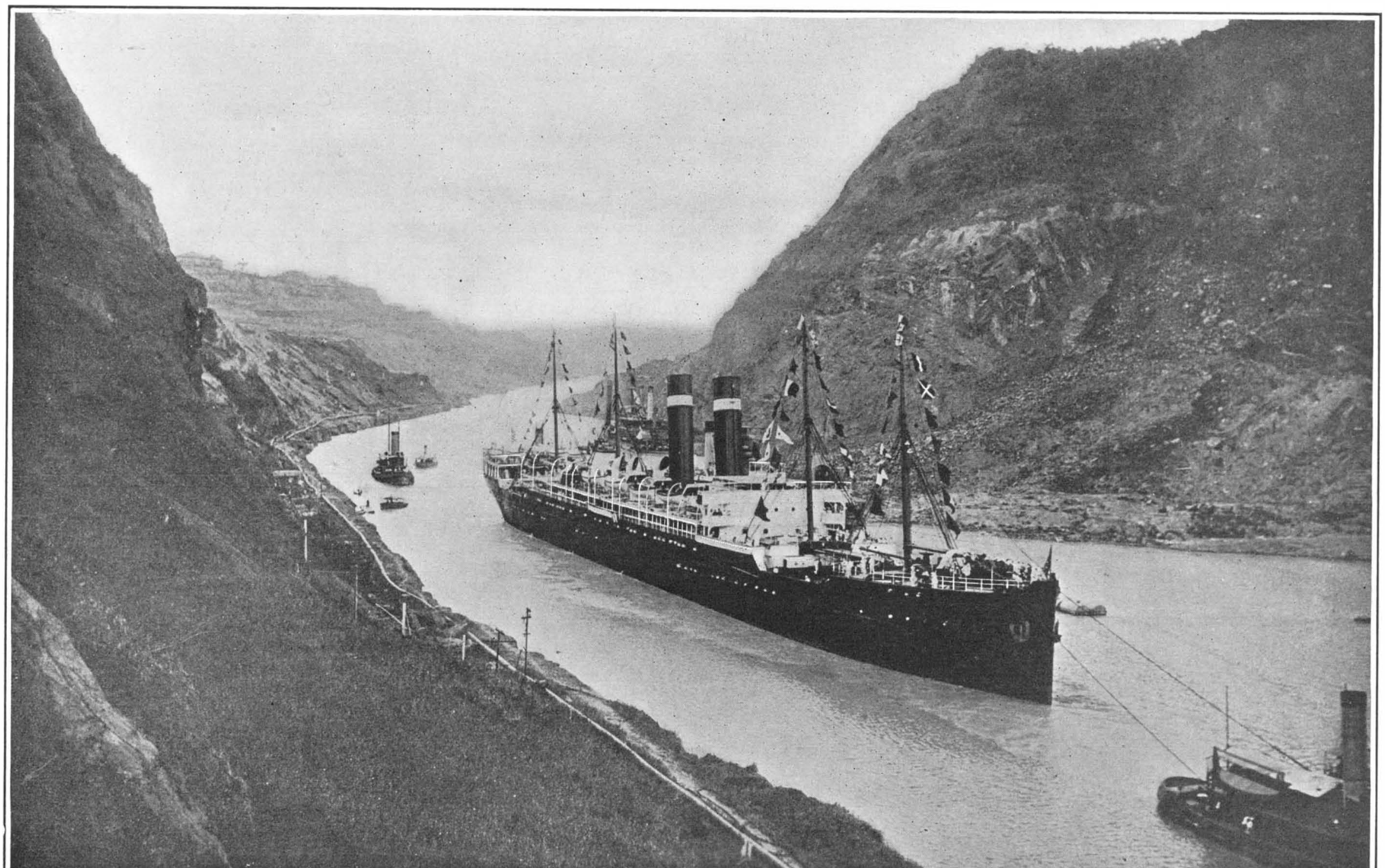
As Congress has recently placed the Department of Agriculture in charge of migratory game and insectivorous birds, in connection with protective legislation, it has become necessary to ascertain the abundance and distribution of the various species throughout the country as far as possible from year to year, so that the effectiveness of protective measures can be tested. The census of 1914 was, therefore, but the first of a series. It was really of a very fragmentary character, embracing the reports of less than two hundred volunteer observers. Each of these selected a tract of farmland ranging from forty to eighty acres and conforming approximately to certain specifications; on this tract a daily early morning reconnaissance was made for several days at the height of the breeding season, and the number of male birds (at that season in full song) was counted; also the number of each species. Each male was assumed to represent a breeding pair.

In this first census only the northeastern States were covered with some degree of completeness, though there were a few scattered observers in the West and Southeast. The results were, however, decidedly interesting and significant. The densest bird population was found at Chevy Chase, Md. (a suburb of Washington), where 161 pairs of thirty-four species were found nesting on twenty-three acres. Here it was noticeable that the blocks most thickly inhabited by people were also most fully occupied by breeding birds. The census showed that the commonest bird in the northeastern United States is the robin, with the English sparrow a close second; while the catbird, brown thrasher, house wren, kingbird, and bluebird follow in the order named. The English sparrow, ordinarily thought of as a city bird, is common on farms, averaging about five pairs to the farm in the northeastern States. A few years ago a severe winter destroyed nearly the whole bluebird population of the eastern States, but the census indicates that there are now several million of this popular species in the northeastern part of the country.

A much more thorough census will probably be taken this year.

## Power Developed in Cannons

MONSIEUR LE COMMANDANT REGNAULT has calculated the actual horse-power developed during the firing of a projectile by some modern specimens of artillery. The results are truly astounding. In the case of a cannon of moderate size, projecting a projectile weighing 7 kilogrammes with an initial velocity of 500 meters, the deflagration of the explosive lasting about one hundredth of a second, we have, during that time, work done to the extent of 115,000 horse-power. For larger artillery, where the weight of the projectile reaches and surpasses 500 kilogrammes, the initial velocity being 900 meters, we have no less than 25 million horse-power developed during the explosion. These figures give an idea of the formidable efforts which the metal of modern pieces of artillery has to support.



**The Panama-Pacific liner "Kroonland" passing through the Culebra cut.**

This fine American-built ship and her sister the "Finland" are about to enter the regular passenger trade between New York and San Francisco *via* the Panama Canal. Each ship is 580 feet long and of 22,000 tons displacement. The "Kroonland" is here seen passing the Cucaracha slide, near the point of deepest excavation.

# SCIENTIFIC AMERICAN

**Founded 1845**

**NEW YORK, SATURDAY, MARCH 13, 1915**

Published by Munn & Co., Incorporated. Charles Allen Munn, President; Frederick Converse Beach, Secretary
Orson D. Munn, Treasurer
all at 361 Broadway, New York

Entered at the Post Office of New York, N. Y., as Second Class Matter
Entered as Second Class Matter at the Post Office Department, Canada.

Trade Mark Registered in the United States Patent Office



**Subscription Rates**

| | |
|---|---|
| Subscription one year. Postage prepaid in United States and possessions. Mexico, Cuba, and Panama | $3.00 |
| Subscriptions for Foreign Countries, one year, postage prepaid, | 4.50 |
| Subscriptions for Canada, one year, postage prepaid | 3.75 |

**The Scientific American Publications**

| | | |
|---|---|---|
| Scientific American (established 1845) | per year. | $3.00 |
| Scientific American Supplement established 1876. | " " | 5.00 |
| American Homes and Gardens | " " | 3.00 |

The combined subscription rates and rates to foreign countries including Canada, will be furnished upon application.
Remit by postal or express money order, bank draft or check

**Munn & Co., Inc., 361 Broadway, New York**

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp* the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.


*The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.*

## For the Defense of the Country

IF ever there was a case of a "tempest in a teapot" it is to be found in the excitement which has been stirred up in Washington over that patriotic movement which is known as the American Legion. The object of the Legion is merely to obtain the names and addresses of those citizens who, in the event of an attack on this country, would be prepared to volunteer for its defense—just that and nothing more.

Whenever war has come quickly upon the country, as in the case of the Spanish war, and the President has sent out a call for volunteers, there has been a great deal of confusion and delay in getting the volunteers together, weeding out the fit from the unfit, and placing the men in their respective training camps. The object of the American Legion is merely to provide and file at certain headquarters lists of competent men, who in an emergency would instantly respond to a call to arms and volunteer for the service of their country.

Surely it is the right of an American citizen to inform the Government that if it should need his services he stands ready on the receipt of letter or telegram to present himself at the place for volunteer enrollment. Surely, the recognition of this right, and the endeavor to have an organized system of properly filed and docketed addresses of these citizens is neither an encroachment on the domain of the army, nor the usurpation of any Government function.

As a matter of fact, this movement is distinctly in line with the policy recently enunciated by our President, when he advocated the preparation of a trained force of citizen soldiery. And if the authors of this movement have asked and received the advice of officers of our Army, given in their capacity as private citizens, we fail to see that there has been the least impropriety of conduct, either on the part of the citizens themselves or of the officers who have been approached.

As a matter of fact, the whole fuss is foolish and puerile, and so far from the movement being discouraged by Government officials, whether of the executive, the legislature, or the army, it should receive from these gentlemen every possible help and encouragement.

The fact is that in the matter of the pressing urgency of national defense, Congress and the whole present administration, with the notable exception of the Secretary of War, is wofully out of touch with the nation at large. We speak advisedly, for the series of articles which we have recently published under the caption "The United States—An Undefended Treasure Land," has brought to this office an unusually large number of letters, strongly commending the stand which we have taken; whereas we have not received a single letter in opposition to the plans for defense as outlined in those articles.

It is our belief, indeed, that the most important, by far the most important, matter which will come before Congress at its next session will be that of providing adequate naval and military defenses for the United States; and if our Congressmen will but take the trouble to get in close touch with their constituents and lay their hands upon the public pulse, they will find that the time is ripe for them to make good the deficiencies of the past, deficiencies which are due more than anything else to the fact that Congress has been playing politics with this question, when it should have given the matter its earliest and most serious attention.

Two years ago in Berlin the writer had a lengthy conversation with a general who is now commanding one of the German armies in the western theater of the present war. Immediately upon introduction, he said: "It is amazing to me that a country as large and wealthy as your own and proclaiming a line of policies of such importance as the Monroe Doctrine, the Open Door in China and the exclusion of the Asiatics, fails to see the necessity for providing adequate naval and military forces to take care of its interests. I well understand," he said, "that yours is not in any sense a militaristic nation; but it seems to me that if you fail to provide an army proportionate to your size and wealth and international policies, you are liable some day in the future to be subjected to a great national calamity."

The defenselessness of the United States is perfectly well understood by the foreign powers, and to every one of them the failure of Congress to provide a reasonable army of defense is looked upon as an invitation to a disaster of the first magnitude.

## Forcing the Dardanelles

A GREAT many unexpected things have happened during the present war, and chief among them is the success with which the allied British and French fleets are forcing the passage of the Dardanelles. This strait, some forty miles in length, fairly bristles with powerful, long-range guns, and its waters are known to be extensively sown with mines. Theoretically it should mean destruction to any ship or fleet which attempts to enter these waters and by the removal of the mines, and the reduction of the forts, break its way through to Constantinople.

Before the opening of the war and, indeed, up to the time of this bold attempt on the part of the allied fleets, it was held that the accuracy of shooting possible by the guns of coast fortifications, and their extreme ranging power, was such as to render it impossible for any warship to come within range without imminent danger of being sent to the bottom. When it comes to a matter of fighting at distances of from ten to fifteen thousand yards, the effectiveness of gun-fire depends, primarily, upon the ability of the contestants to estimate the range of the ship or the fort as the case may be. The distance is estimated by the well-known system of triangulation, in which the length of the base line is known and also the two base angles. The accuracy of the distance, as thus calculated, will naturally increase with the increase of the base line upon which the calculations are determined. On the ship, the triangulation is done automatically by a range-finder in which the base line is from, say, nine to twenty-one feet in length; and everyone will recognize that a calculation of a distance of twelve to fifteen thousand yards on a base line of seven yards requires great accuracy, both in the instrument and its adjustment by the observer. When the shots begin to land on the fort, observers on the ship attempt to "spot" the fall of the shot by the dust which is raised, or by the smoke of the explosion—a very difficult matter, particularly when the fortification is elevated above sea level.

Calculation of the distance of the ship by observers in the fort is more accurate because a base line of great length, even up to a mile, may be used, and the angles at the ends of this base line to the ship can be most accurately determined. Furthermore, it is possible to observe the splash of the shots, and determine how much they are over or short of the ship with great precision, particularly if the fortification is elevated considerably above sea level. Furthermore, the fortification guns are on a solid platform and the gun-sight may be held absolutely upon the mark. There is no such quick manipulation of the guns by the pointer as is necessary on a ship which is rolling several degrees.

Consequently the rapid success which has attended the attacks of the allied fleets is causing great surprise. Indeed, it is difficult to account for it, except on the ground that the heavy guns of the Turkish forts are of old pattern and low velocity, and the work of the gunners is far below the standard which has been reached in naval gunnery.

There are two stages of progress—first the night operations of a fleet of destroyers and lighter cruisers in removing the mines in advance of the battleship fleet. When a stretch of the strait has been cleared, the fleet moves forward, and, at a predetermined distance, steams to and fro, raining shells from its ten and twelve-inch guns until the forts are breached and the guns dismantled. If the allied fleet succeeds in forcing its way through the strait and reaching Constantinople, the exploit will constitute the most brilliant feat of its kind in the history of naval warfare. With Constantinople under the guns of the fleet, its fall is certain. With its fall, the era of Turkish rule, or rather misrule, in Europe will have closed forever.

## Overcrowding and Health

IN the controversy between the Health Commissioner of this city and the Chairman of the Public Service Commission, on the subject of overcrowded cars, the sympathies of the public will naturally be with the Health Commissioner. The Board of Health in the exercise of its undoubted right to forbid the conduct of any business in a manner which constitutes a nuisance prejudicial to health, has called upon the Public Service Commission to exercise its authority over the transportation companies and prevent injurious overcrowding on two crosstown surface lines in this city. The Commission has replied that the overcrowding can be prevented only by hanging out a sign indicating that the car is full, as soon as the occupants number 50 per cent in excess of its seating capacity. This would be to adopt, in principle, the continental system of displaying a sign as soon as every seat is occupied, thereby indicating that no more passengers can be taken. In view of the enormous number of passengers traveling day by day in this city, and the rush with which the city's daily life is carried on, we believe that there would be a public outcry against the adoption of any such system—and this for the reason that rather than wait for a seat, the average American traveler is willing to undergo the inconvenience of "strap-hanging."

But, as the Board of Health points out, there is another and better way in which overcrowding can be prevented, and that is by putting more cars into service during the hours in which the worst crowding occurs. It is the practice of the transportation companies, and especially of the subway operating company, to cut down the size and number of trains between the rush hours. If this were done judiciously, there could be no objection to the practice; but almost invariably the reduction in the number and frequency of trains is such as to cause overcrowding to continue throughout the whole day. The same conditions exist on many of the surface lines, both in Manhattan, the Bronx, and Brooklyn.

The Board of Health is certainly within its rights in drawing attention to this unnecessary crowding, and the irritation shown by the Public Service Commission in its reply to the order of the Board of Health seems to indicate that the former body has not gone very wide of the mark in calling the Public Service Commission to account. It is the duty of the Commission to keep in very close touch with transportation conditions, and particularly should it watch this matter of overcrowding. When the Board of Health considers that the overcrowding has reached the point at which the health of the traveling public is so greatly endangered as to call for a definite protest against the practice, the public may rest assured that the danger is a very real one and that the possibilities of infection and contagion due to the herding of people in confined spaces for a long period of time are a positive menace.

The present commissioner of the Board of Health is held in very high repute in his own department, which is thoroughly in accord with him in the protest which he has made. The Public Service Commissioners were appointed to their very lucrative positions in order that the interests of the traveling public might be thoroughly safeguarded, and now that the menace to the public health due to overcrowding has been brought to their attention by so high a technical authority as the Health Commissioner, the public will hold them to account if they fail to do everything that is in their power to remedy the existing conditions.

## Plant Autographs and What They Mean

THE dramatically interesting investigation outlined in the article on Plant Autographs appearing elsewhere in this issue is highly significant. It was conducted by Prof. Jagadis Chunder Bose as a continuation of a remarkable series of studies which culminated in positive proof that inorganic matter is as responsive to crucial electrical tests as organic matter. In other words, there is but one matter, whether it is living or non-living. The investigation described proves that there is no difference between plant and animal life in response to environment, and that the barrier long supposed to exist between the two is purely arbitrary. If all matter is alive, if it is wrong to set up barriers between the living and the non-living, surely we must speak not of "sciences," but of "science." There is but one matter, one science, one truth, and all outwardly different matters, all sciences and all truths are part of a great unity. It is poetically fitting that this should have been taught by a descendant of Hindu philosophers, who arrived by sheer speculation at conclusions which he has verified with the objective methods of modern science. In this remarkable investigation, therefore, the synthetic intellectual methods of the East co-operate with the analytic methods of the West in a single mind. In science, at least, all nations meet on a common ground of understanding, although half the nations of the world are at war.

## Panama-Pacific Exposition Notes

**Many Associations to Meet at the Fair.**—Nearly four hundred State, national and international associations have already signified their intention to hold conventions at San Francisco during the fair season, and for these ample accommodations have been made. Most of these will be held in the big Convention Hall on the grounds, but there will also be many important and interesting gatherings in the State buildings, a number of which have made provision for such meetings.

**Statistics of Numbers and Weight.**—The total weight in exhibits handled by the traffic department is 80,000 tons. This hardly conveys an adequate idea of the immensity of the exhibit scope, although speaking roughly it would approximate a ton for each exhibitor. The gross of tonnage measurement is 500,000 tons. The number of individual packages, bales, crates and boxes handled runs so far over a million that additional figures would lend little emphasis.

**Guarding the Roses.**—Exposition guards have already been established to keep careful watch over the growing rose bushes that have been entered by famous growers of the world in competition for the $1,000 prize for the best rose, hitherto unnamed and never before exhibited, which can be produced. This rose, when the award is made, will be given a name that will pertain to the exposition, thus perpetuating the name and the glory of the exposition through the medium of a lovely bloom.

**Arrangement and Appearance of the Fair.**—The Panama-Pacific Exposition occupies a space of 2½ miles along the water front of the Golden Gate, nestling at the foot of a range of hills that forms a fitting background for the picturesque collection of buildings, which, with their domes, spires and minarets, is suggestive of some old time oriental city. By day the varied colors of the buildings against the verdure of their settings present a scene of harmony, while by night wonderful effects produced by the flood of electric light, ingeniously diffused throughout the grounds, are entrancing in the extreme. The exhibition buildings occupy the center of the scene, as viewed from the bay; to their right are located the buildings erected by the different States and foreign countries represented at the fair, together with race track and fields for aviation and out-door sports, while the left hand portion of the grounds is given over to the amusement features, a region known as the "Zone."

**Bewildering Array of Articles Sent.**—From the safe custody and transferring of three grains of radium, swathed in protecting coverings and guarded jealously, to the handling of the 1,500-ton exhibit of the United States Steel Corporation the details of installation have run the scale of the multifarious articles of art, industry, commerce and general activity. Eucalyptus trees a hundred feet in height and a foot thick at the base, palms from Cuba and South America with a 24-foot spread and a 4-foot base, orchids from the Philippines, from Australia and the Netherlands, works of fine art by world masters, ceramics from Italy and porcelains from Austria and satsuma and faience from Japan—perishable and imperishable, breakable and unbreakable; live beavers from Idaho and stuffed elk from Canada, big and little articles of dress and fabrications beyond price, all have had their day with the elaborate organization in charge of traffic. They all came jumbling and tumbling through the great arteries of transportation that led to the exposition grounds, but they went their separate ways through the finer capillaries until the minutest corpuscle was distributed to the smallest cell waiting for it.

**Installing the Exhibits.**—Four thousand workmen, working three shifts a day, a half dozen engines hauling box and flat cars of exhibits directly into the exhibit palaces, automobile trucks by the score and drays by the hundred, swinging derricks and whirring winches by the dozen combined during the few days before the opening of the Fair to present a scene of high pressure activity at the grounds of the Panama-Pacific International Exposition. The work of installing the myriads of exhibits was something that few people can imagine. Naturally the exhibitors delayed sending their consignments until the last moment, so that when they did begin to arrive there was an avalanche from every quarter of the world. Countless crates, cases and bales flowed in both by rail and by water, and except for an elaborate and efficient system of sorting and distribution, that had been carefully worked out by the management utter confusion would have arisen, for it must be remembered there are 80,000 exhibitors represented on the grounds. A system of tracks led to and into every exhibition building, and by means of these the car loads of freight, which the railroad companies transferred on floats directly to the exposition docks, were quickly and without confusion run to the particular building to which the exhibits were consigned. Once there, powerful cranes were ready at hand to unload and place the heavy pieces directly in their places. Steamships from foreign lands docked at the same place, and their cargoes were similarly handled.

## Science

**To Remove Garlic Flavor from Milk.**—Recent investigations in the Dairy Division of the U. S. Bureau of Animal Industry have proved that the flavor of garlic may be entirely removed from milk by blowing air through it while it is held at a temperature of at least 140 deg. Fahr. An exposure of 30 minutes at 145 degrees is sufficient to free milk from the most objectionable flavor. A somewhat longer exposure is necessary for cream.

**Hardy Spineless Cacti.**—The U. S. Bureau of Plant Industry reports that in the course of its explorations in the southwest in quest of new species and varieties of cacti, three species have been found which promise to be of much economic importance. They are remarkably smooth and remain so under cultivation, grow rapidly, and will be hardy in the San Antonio and Austin regions. With the aid of these new forms in breeding operations it is hoped to increase the cold-resistance of the ordinary spineless species from 10 to 15, or possibly 20 degrees.

**The Gypsy and the Brown-tail Moths.**—The U. S. Bureau of Entomology reports encouraging progress in its fight with these formidable pests. Both insects have conspicuously decreased in numbers, especially the brown-tail, which suffered severely from the weather of last winter and from the work of the brown-tail moth fungous disease and imported parasites. The Bureau prepared colored posters illustrating the gipsy moth and its natural enemies, and these were posted in all postoffices and town offices in infested districts. Post cards bearing the same illustrations were distributed by mail and by the Boy Scouts.

**Relation of Malaria to Agriculture.**—An intensive study of the decrease of productiveness in an agricultural community due to malaria has been made by the Bureau of Entomology in Madison Parish, La. It was found that 12 families, cultivating 246 acres of land, lost an aggregate of 88 weeks during the crop-growing season from this cause, or more than 7 weeks per family. The financial loss in this case was estimated at $24 per family. Where the boll-weevil prevails the losses would be much heavier, as failure to keep up the cultivation of the crop or to plant at the proper time gives the weevil a decided advantage. It is clear from these investigations that the present loss through malaria in the southern States amounts to many millions of dollars.

**The Cotton-boll Weevil,** according to a report of the U. S. Bureau of Entomology, has changed somewhat in structure since entering the United States, and has also become adapted to greater severities of climate. Moreover, it is now able to obtain subsistence and possibly to develop on certain plants related to cotton, among them being *Hibiscus syriacus* and *Callirhoe involucrata*. In some of the mountain canyons of Arizona the weevil has been found on the so-called Arizona wild cotton, *Thurberia thespesioides*, and this western form of the insect shows even greater adaptivity to climatic extremes than the eastern variety. Hence considerable fear is felt for the success of western cotton growing, and the Bureau of Entomology has been making a special study of the situation. During the year 1913 the weevil spread over 17,700 square miles of new territory in the United States, and caused a primary loss in production of the area planted in cotton in that year of about $30,000,000.

**A Humane Aigrette Industry.**—The latest "Webster" dictionary says of aigrettes that "they grow only during the breeding season, so that in obtaining them not only are the parent birds killed, but the young are left to starve. The egrets producing them are therefore fast becoming extinct." While this statement is true of the aigrette industry as heretofore generally conducted and the cruelty of aigrette hunting has led to widespread legislation intended to discourage traffic in these feathers, it appears that a perfectly humane method of obtaining the latter has been evolved in India. In the *Journal* of the Bombay Natural History Society Mr. George Birch, assistant commissioner of the province of Sind, reports that egrets have been very extensively domesticated in that province. The birds are bred in captivity, and are plucked of their "ospreys" or aigrettes without suffering any injury, just as in the case of ostriches. The conditions of captivity make them more productive of aigrettes than are wild birds, as the young are taken away from their parents, to be reared by hand, when about a week old, and the parents then breed again. Thus the nuptial plumage, which is all that is commercially valuable, is assumed four times a year. The birds are liberally fed with fish, and are so tame that they allow themselves to be seized without showing any fear. The killing of egrets for their plumage was prohibited in the province about 30 years ago. The practice arose of snaring the birds and keeping them in captivity, but this led to the cruel custom of stitching up the birds' eyes in order to prevent their escape. After the authorities put a stop to the latter feature of the industry, egret farming became so humane and legitimate a business as to render unnecessary and unreasonable the present law against shipping the feathers out of India. The industry has become extremely profitable.

## Aeronautics

**Explosive Darts Against Zeppelins.**—R. F. Robertson, of Dublin, Ireland, has just perfected an invention designed for the destruction of Zeppelin balloons by aeroplanes. He is said to have received a large order from the French and British army departments. The invention consists of a steel dart, fitted at its rear with fish-hook-like projections. The dart is hollow and contains an explosive which burns with a fierce sharp flame. When such a dart is dropped from an aeroplane upon a Zeppelin or other gas balloon, the hooks catch in the fabric after the point of the dart has pierced it and the explosive charge is ignited by the pulling backward of a friction detonator. As the explosion takes place inside the gasbag its effects are expected to be disastrous.

**Sperry Experiments with His Stabilizer.**—Lawrence Sperry has lately been experimenting with his automatic flying boat around New York, and among other things has tested the automatic volplane device in connection with the gyroscope control. It is reported that this is a small instrument resembling a windmill, which acts upon an electric switch, putting into action the auxiliary motor that works the controls. The action obtains only when the windmill's speed is reduced through the slowing of the aeroplane by engine stoppage or other cause when the elevator is operated to head the craft downward. A curious accident occurred during one flight, when a small sheet copper patch on the propeller loosened and was shot through the hull of the boat, causing a leak.

**Eight-cylinder Motors Exported.**—How quickly the American 8-cylinder gasoline motor has forced its way to the front, is plainly shown by the fact that one of the latest types of this motor is used in certain hydro-aeroplanes, which have been ordered by the Allied governments. The motor in question is the Hershell-Spillman engine, which is being used in at least two of the 1915 models of motor cars. Its flexibility, power and lightness have served to draw attention to it as a probable motor for aeroplanes and hydro-aeroplanes. It is reported that the German government has lodged an official protest against the manufacture and export of these motors to the Allies. The protest was disallowed, and the motors are now being installed in hydro-aeroplanes at Hammondsport, N. Y.

**$5,000 for Army and Navy Airmen.**—When Glenn H. Curtiss took part in competitions he found that trophies were great incentives to good work, and to promote healthy emulation and to aid in the development of aeronautics in the army and navy he has not only offered a trophy worth $5,000, to be competed for annually, but will give five purses of $1,000 each to those accomplishing the best results. These prizes are offered through the Aero Club of America, and the rules of the contest will be arranged by a committee composed of members of the club and of the army and navy. That some encouragement is due to the progressive men in the Government service will be appreciated when it is pointed out that the appropriations made for aeronautics for the coming year by the United States Government will not permit of the maintenance of more aeroplanes than Montenegro or Turkey has.

**Seaplanes for the Navy.**—Bids on the first open competition for hydro-aeroplanes for the United States Navy were opened on February 27th, and the department was much gratified over the fact that fifteen concerns participated. Six machines are required, and the general specifications call for biplanes of a sea-going type to carry two persons, guns, ammunition, wireless outfit, and a certain amount of armor. A speed of from 50 to 80 miles per hour is required, and they are to weigh between 2,500 and 3,000 pounds, with an average carrying capacity of 600 pounds. All information as to the plans and details of the proposed machines is refused, so that any comparison of the bids as submitted is impossible. The following is a list of the bidders, and the prices named by each for a single machine. It will be noted that the Gallaudet Company bids for but a single machine, and the B. F. Sturtevant Company and the Tygard Engine Company put in figures for the power plant alone.

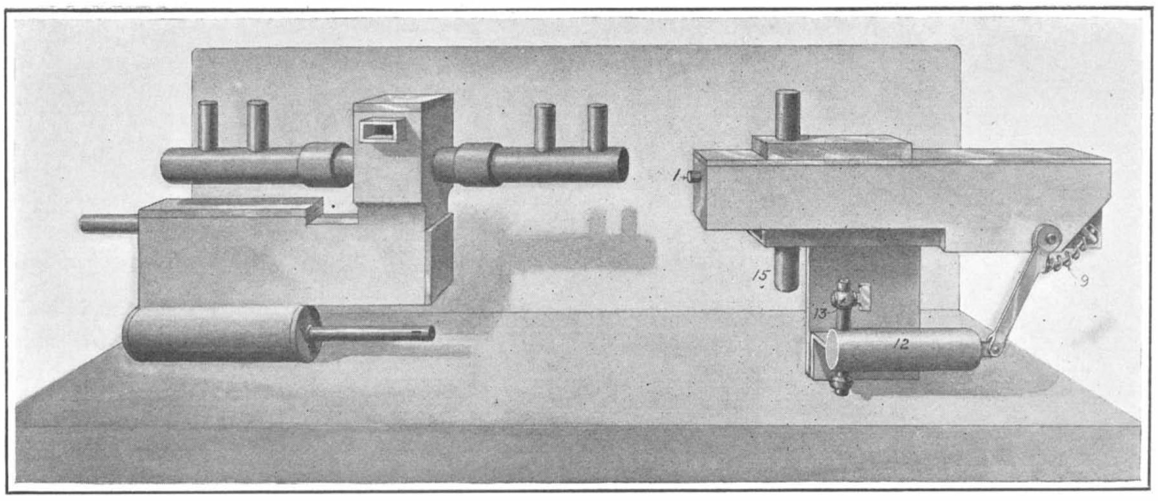
| | |
|---|---|
| Aircraft Company, Inc. | $12,820 |
| The Burgess Company | 11,005 |
| The Curtiss Aeroplane Company | 17,925 |
| Gallaudet Company, Inc. | 18,000 |
| Grinnell Aeroplane Company | 15,000 |
| William C. Hurst | 11,000 |
| Peopli Aeroplane Corporation | 7,300 |
| Shaw Aeroplane Company | 8,500 |
| The B. F. Sturtevant Company (motor only) | 4,325 |
| Thomas Brothers Aeroplane Company | 8,900 |
| E. Thomas Brothers Aeroplane Company | 12,980 |
| The Tygard Engine Company (motor only) | 14,000 |
| The Wright Company | 15,000 |
| B. Stephens & Son | 6,600 |
| G. H. Armitage | 8,350 |
| A. M. Herring | 6,900 |

The specifications under which the bids were submitted included a number of heads, and it will require some time to classify and consider the figures contained in the bids.

## A Machine That Remembers and Forgets

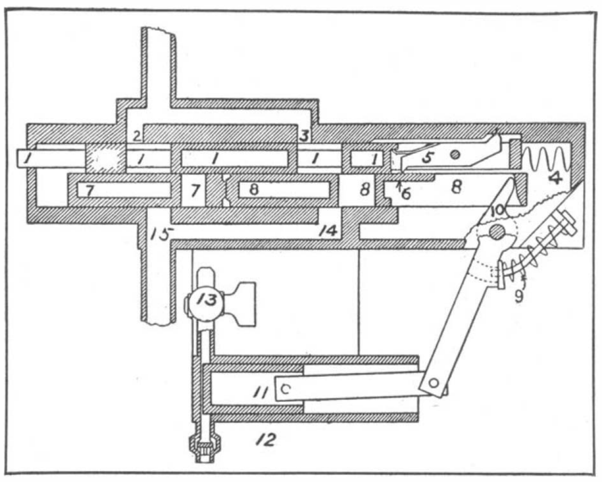
By W. H. Dearden

A MACHINE that can learn things and then will forget them if it is not kept in practice, that can form habits like a living being, and is, in fact, intended to imitate the memory processes of life itself, has actually been invented and built. It is now attracting the keen interest in the small circle of scientists who know of it. Because it has a memory like a brain, very limited, of course, but astonishing enough even at that, it might be called a "brain machine."



Transmitter (on the right) and receiver (on the left) of the remembering machine.

An example of what the brain-machine could readily be made to do will show its marvel. Any electrical student could construct a little apparatus which would



Mechanical brain of the remembering machine.

move toward the warmth of a fire and then would move back again when it came so close that the heat was excessive. Such an apparatus, not at all wonderful in itself, could be attached to this brain-machine and the wonders would begin. If a fire was placed near the machine it would move toward the heat, like a little child or an animal who felt cold. When the machine came so close that the heat was excessive, it would move back like a child or an animal who had come too close and suffered a burn.

After one or two such experiences, the brain-machine would have learned its lesson. If fire were then placed near it, it would not move up; in fact, it would probably back away as if it were afraid of being burned. Again and again the experiment might be tried, and the machine would keep away from the fire. However, let the machine rest for awhile, say over night, and it would forget. Then, if the fire were placed near it, the machine would move up and again be burned and jump back. This would teach the lesson again, and the "habit" of not being burned would have again been acquired, but only frequent experience would keep the machine from forgetting.

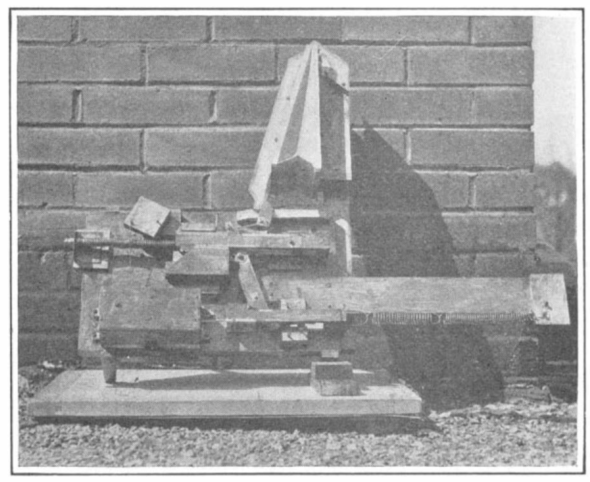
The inventor of this curious apparatus is not a visionary dreamer, but a practical mechanical engineer, S. Bent Russell of St. Louis. He has become deeply interested in the whole science of nerve and brain study. The idea came to him that the engineering profession has so far contributed little or nothing to brain study, and yet probably has much valuable knowledge that could be used there, and so he determined to help the psychologist by constructing a mechanism which had associative memory, thus proving that associative memory, at least in some form, could be a matter of mechanism.

It is a simple process of the nervous system which Mr. Russell sought to imitate. If an impulse proceeds along one nerve channel in an animal, and then, when it gets to the end invariably it is followed by a second impulse along a second channel, and this sequence is repeated often enough, there will soon be what might be called a short-cut channel from the beginning of the first impulse to the end of the second impulse; the starting of the first impulse will be enough to cause the second action. An essential part of the machine is a valve which will open wider the more often it is used and the more recently it has been used. This valve is the ordinarily dull nerve channel that develops into an active open channel with frequent use. Compressed air may be used for power, and thus with the use of this valve the amount of power applied at one place depends upon how often the power is applied to that one place, and how recently. If the power is applied often the valve opens wide and acts at that one place surely and effectively, but if it is applied seldom, the valve only opens slightly, and most of the power will go to an entirely different spot and accomplish an entirely different result.

The diagram represents one of the transmitters of Mr. Russell's machine and shows its essential principle. The slide valve 1 is shown at the extreme end of its inward stroke, or stroke to the right, as in receiving a signal, and this is known as the spur valve. When it is in this position it opens ports 2 and 3 to admit pressure (in this case we shall assume that hydraulic pressure is used). It is the final destination of the water entering ports 2 and 3 that determines what action shall follow an impulse. The spur valve spring 4 is now compressed. The pawl 5 which is attached to the spur valve is pressed by a spring into engagement with the ratchet 6. Valve 1 slides over the lag valve 7 and the ratchet valve 8.

The ratchet valve 8 is shown in the figure in its original position or right-hand end of its stroke. When valve 1 is permitted to make its return or outward stroke the valve 8 moves also, pushed by pawl 5, but valve 8 cannot move far, as the pawl is soon tripped by the lug on its top striking the casing. When the ratchet valve 8 is thus released, it moves back to the right, driven by lever spring 9, acting through the rocking finger 10. As this action is taken, the dashpot plunger 11 is driven back by the force of this same spring 9; and conversely, when valve 8 slides to the left, it sucks air into dashpot 12 through a check valve, and this air can only pass out through adjusting cock 13. In this way the return stroke of the ratchet valve 8 is very slow, being controlled by the speed of the air passing out of 13. If the time interval before a second stroke of spur valve 1 is long enough, ratchet valve 8 will have reached its original position, and its second stroke will be the same as the first and lag valve 7 will not be moved. If, on the other hand, the time interval is so short that the second stroke of the spur valve comes before the ratchet valve has arrived at its original position, the ratchet will cause the ratchet valve to advance farther to the left than before, and hence the lag valve will be advanced farther to the left. Now, the farther valve 8 moves to the left the greater will be the effective opening for water pressure from port 3 to issue port 14. Hence, the effective opening at any stroke will be in inverse proportion to the time interval since the last stroke. In other words, the passageway will gradually close between strokes. In the case of the lag valve 7, the farther it moves to the left the greater will be the effective opening for water pressure from port 2 to issue port 15.

Its application to the idea is simple. The more often the spur valve 1 is operated back and forth the bigger will be the opening through 3 and 14, or the more active will be this nerve channel. The size of that opening is controlled by valve 8, and it will be seen that the forgetting part of the machine is the dashpot 12. When the plunger 11 is pushed all the way in, the machine has forgotten. When it is pulled out, the machine remembers, or keeps the 3-14 channel open. By allowing the air in the dashpot to escape slowly through 13, the time in which it takes the machine to forget can be controlled.



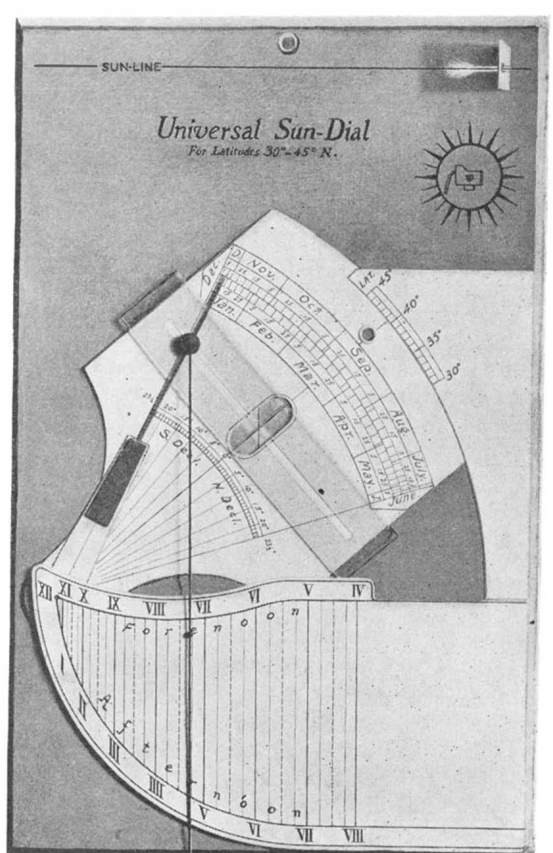
A modified form of the "brain" machine.

In combining a number of these units together some more ingenious mechanism has been made, but the unit is the essential principle.

## Universal Sun-dial

IN the SCIENTIFIC AMERICAN of August 10th, 1912, we described a sun-dial similar to the one shown in the accompanying engraving, but which, unlike this one, was not adjustable for various latitudes. For the benefit of those who did not see the original article, we will explain that, in use, sun-dials of this type are swung in a vertical plane until the shadow cast by the gnomon falls on the "sun line." In the present case the gnomon shown in the upper right-hand corner, contains a keyhole slot, and the sun-dial is adjusted to center the light shining through this slot, upon the sun-line. Then the time may be determined by noting where the plummet line crosses the forenoon or the afternoon hour line, as the case may be. Of course the point of attachment of the plummet line must be adjusted for the day of the year, as a moment's consideration will prove. At sunrise and sunset the shadow of the gnomon is horizontal, and the plummet line must lie parallel with the lines connecting the forenoon and afternoon hour curves.

But in the latitude of New York, for instance, the sun sets at about 4:30 in December and 7:30 in June. Evidently then the plummet should be hung from different points at different times of the year. To provide for this adjustment, the sun-dial here shown has a sector graduated with a date scale, and a pointer carrying a button to which the plummet line is attached. As the pointer is moved to the date on which the observation is taken, the button which slides freely on the pointer and also in a slot cut in a celluloid plate, travels on a straight line instead of a curve. The arrangement is such that the plummet is adjusted for the variations of the sun's declination at different days of the year. The actual value of the declination may be read on a scale on the sector. If this sun dial is to be used in more than one latitude, a further adjustment is necessary. This is provided by making the sector movable with respect to a latitude scale. Our illustration shows the sector adjusted to latitude 40½ degrees. The celluloid plate must be set with its slot centered over the point where a center line of the sector crosses a fixed vertical line. Thereafter the pointer may be set for the date and the sun-dial may be used as described above. The inventor of this ingenious sun-dial is Mr. W. Leinert of New York city.




Sun-dial adjustable for various latitudes.

"Sweeping"—Another blind alley occupation.

The regular grade school has been unable to develop these boys.

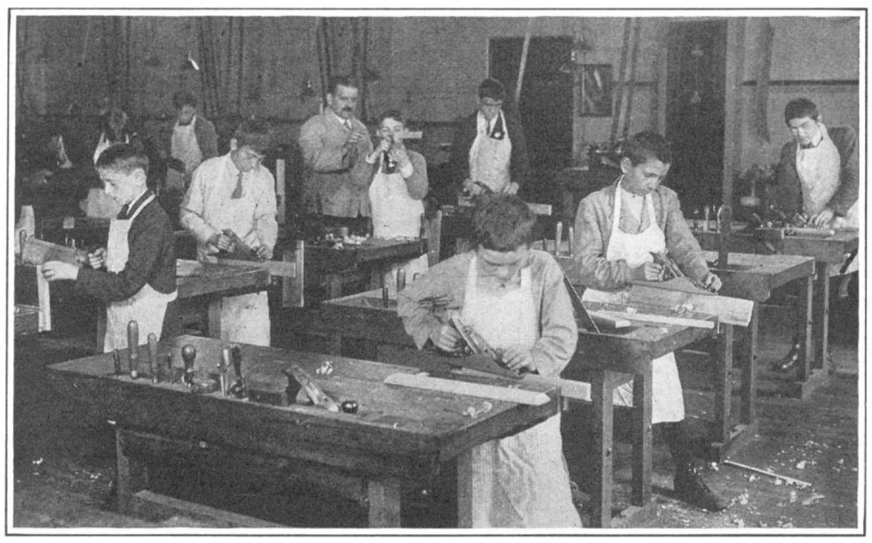
# The Educational Scrap Heap and the Blind Alley Job

## The Need of Opportunities for Working Youth

By L. W. Dooley

A MATTER that is of great economic and vast sociological importance is the rapidly growing army of the unemployed, the great majority of whom are not qualified to fill positions requiring skill or special training, and yet lack the education necessary to enable them to undertake anything but manual labor. That the source of these conditions lies in our educational system is explained in an article in the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT by L. W. Dooley, who discusses the subject at length and makes practical remedial suggestions. An outline of this article is given in the following paragraphs, and it is evident the article is well worth the attention of all interested in sociological conditions.

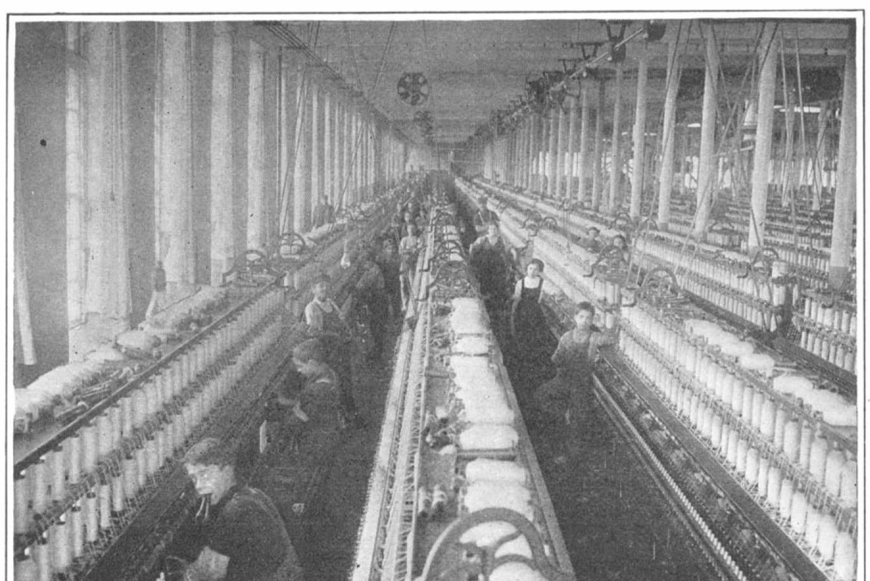
Waste is repugnant to us to-day. This same cry of greater efficiency of the modern time has entered our educational system. Citizens and public spirited men are criticising our schools through the newspapers and magazines. They claim that there is great waste in our schools, the essential is neglected, and the boys and girls are not properly prepared for life. The practical abandonment of the apprenticeship in the country, except in a few isolated places like Brown & Sharpe Manufacturing Company, is bringing about a want of skilled workmen which the modern industrial system is failing to supply. On the other hand, the great number of unskilled workers have increased, and all of them have not been able to obtain employment. The great industrial demand of the present and of the recent past is making this want felt more and more sharply. The whole country is awakening to the necessities of the case and demanding a remedy. Organized educational forces are moving rapidly in the direction of making our school system more practical. There can be but little question that our school system has lagged behind the development of those forces of business organization with which they should be clearly articulated. Our school system is only just now entering upon the stage of efficiency which industry has long since considered. Nowadays educational experts are beginning to see that the dull pupils can be rescued and that stupidity has various causes, a great many of which may be cured. In years gone by, if a girl or boy did not get on well in school, he or she was most likely noted as being just plain stupid, and called a dunce, and allowed to drag along until the day came when they would leave school. These children have been referred to as the scrap heap of the public school system. This educational scrap heap, designated by our present school system as worthless, has great imitative power and capacity for mechanical work and experiences no difficulty in obtaining work at a high initial wage in what are called by our social workers "blind alleys" or "dead end" employment, that is, employment such as messenger boys, attendants in bowling alleys, doffers in mills, attendants in glass, factories, etc., in which the experience gained under the present industrial and educational conditions is said to form no basis for advancement into more skilled and better paid



Training for a skilled trade.

work as the child grows older. When these young men reach the age of eighteen they have passed their usefulness in this type of juvenile work, and find there are not positions enough for them in other parts of the mill, and they leave and form our great unskilled army.

In order to reduce our so-called educational scrap-heap it is necessary to change our school system so that it will educate the whole boy and girl of this day. A manual training department should be attached to every school in this country. Children should be taught as soon as they go to school to use their hands, as the father and mother did in the rural communities a generation ago.



"Doffing"—A blind alley occupation.

We must act on the principle admitted by everybody who knows or cares anything about education, that the way to secure a good training for the mind is not to end the school life at the most plastic period, fourteen years of age, or in the case of foreigners, as soon as they can pass an examination, but to insist that every boy shall spend a certain number of hours a week under educational training and sound teaching till he reaches manhood.

In order to overcome the educational weakness of our present dead end or blind alley occupations, we must provide opportunities for working youths on a part time system, an education which will meet with their interests and tastes, assisting each to become proficient in some line of work that he may enter after passing his usefulness in the so-called blind alley position. Our public school system should audit our social accounts and publish the opportunities available to young people, that they may choose their life work scientifically, and in this way reduce our scrap-heap of unskilled labor to a minimum. Blind alley jobs will then become ports of entry into more skilled and profitable positions.

### Toothbrush Holder and Sterilizer

THE man who cares to subject his toothbrush to a microscopic examination will find that even though his teeth and gums are in sound condition, the bristles of his toothbrush will be swarming with millions of organisms. This filthy condition can be kept down to some extent by the use of antiseptic toothpowders and pastes, but a still more effective method has recently been devised, which will render the brush absolutely sterile. The handle of the brush is made hollow and can be unscrewed from the brush proper, forming a receptacle into which the brush may be inserted. Inside the handle a disinfectant is kept which will sterilize the brush. The brush sealed in its hollow handle makes a very convenient package for travelers who now have difficulty in keeping their brushes out of contact with dirt.

---

**The Supreme Court and Unfair Competition.**—The Supreme Court in the case involving L. E. Waterman Company and Modern Pen Company among other things said that when the use of his own name upon his goods by a later competitor will and does lead the public to understand that those goods are the product of a concern already established and well known under that name, and when the profit of the confusion is known to and, if that be material, is intended by the later man, the law will require him to take reasonable precautions to prevent the mistake.

## The Commissioner of Patents on Compulsory Licenses*

THERE is agitation growing largely out of the conditions created by the war, in favor of the introduction of compulsory license and compulsory working of patents in this country.

The embarrassments of the present situation are perhaps most keenly felt in the dye and drug trades. I shall not undertake to minimize the difficulties, but they certainly do not all arise out of our patent system. The difficulties are economic. They are very acute in Great Britain in spite of provisions of her patent system which we are urged to adopt. If all of the patents now held by Germans and not worked in this country, relating to chemicals used in these two trades, were thrown open to the public, it would involve a large investment of capital to prepare to manufacture these chemicals here. At a conference held in the office of the Secretary of the Interior shortly after the war began, the statement was made by an expert in the dye trade that it would require about $100,000 of investment per color to supply the market of the United States with dyes. The point was made then and has been frequently made since, notably in the *Journal of Industrial and Engineering Chemistry* of November, 1914, that protection against resumption of competition from Germany, in excess of what is now provided by the Tariff Act, is essential. I shall not discuss the tariff, but limit my discussion to proposed changes of our patent laws.

The first thing to be considered is that compulsory working, revocation, and compulsory license must be made applicable to all patents granted in this country. It has been proposed to limit them to patents granted to foreigners. We had a somewhat similar provision in our law from 1836 to 1870. But the entire body of treaties known as the International Convention which have been negotiated since that time are based upon the fundamental provision of Article 3, that "The subjects or citizens of each of the contracting countries shall enjoy in all of the other countries of the union . . . the advantage which the respective laws now grant, or may hereafter grant, to the citizens of that country." This article embraces not merely patents of utility and design, but also trade-marks. Any departure from this convention would render nugatory the work looking to enlargement of trade which has been done in connection with these treaties during more than thirty years. In addition to the International Convention, we have a special treaty with Germany, proclaimed August 1st, 1909, which has been liberally construed by the German courts in favor of American citizens. We may, I think, therefore dismiss all suggestions that these new provisions be limited to foreign patentees.

A recent report transmitted by our Consul General at London, dated October 22nd, 1914, states that at the end of 1912, after the Act of 1907 had been in operation in Great Britain for five years, about $50,000 per week was being paid in Great Britain as wages in factories established because of the compulsory working features of that Act, and that by the end of 1913, $10,000,000 had been spent for factories and equipment. This sum divided over five or six years is not very impressive, but leaves ample room for the argument that the disturbance of the patent system introduced by this compulsory feature outweighs the pecuniary advantages assuming the latter to be entirely genuine.

In Great Britain a curious result has been evolved by judicial construction. Among the cases reported in the *Illustrated Official Journal* is that in the matter of Hatschek's's patent (1909 *Journal*, page 228). Here Mr. Justice Parker held that the question is not whether the market of England is supplied mainly or satisfactorily by manufacture of the invention conducted in England, but whether England as one of the great commercial nations of the world is enjoying her fair share in the manufacturing and marketing of the invention. See what a vast field such a conclusion opens. The endeavor to investigate the trade of the industrial world in any patented article, and the question what proportion Great Britain is entitled to in view of her standing as a manufacturing nation, would involve, if adequately gone into, a record which would make the Selden record look like a Webster's spelling book alongside of one of his unabridged dictionaries.

In an address before the Board of Trade last June, Mr. Levenstein, to whose efforts the passage of the requirement of the compulsory working was largely due, while claiming that the prospect of benefit from this section was bright at the start, frankly admits that it has been a failure. He attributes this not to the difficulty which I have pointed out above, but to an opinion expressed by Mr. Justice Parker, also in the Hatscheks case, to the effect that the burden of proof that the manufacture is carried on mainly or exclusively outside of the United Kingdom must be borne by the petitioner for revocation. Mr. Levenstein says: "The mischief, if I may call it so, became at once apparent. While we had about seventy-three applications up to the end of 1909, there was one patent revoked in 1910, and in this instance I suppose it was revoked because of no defense. In 1911 no proceedings were reported. In 1912 there was one application, and in 1913 there was one revocation."

In Germany during earlier times they had a drastic compulsory working enactment, but since 1911 the working clause has been substantially identical with the clause in the British statute. I am not informed specifically as to how it has worked in Germany. But DuBois Raymond, an eminent German authority, in his paper published in the Report of the Investigation of the United States Patent Office (1912, pages 434-435), says: "I do not know of a single instance in which a firm, to comply with the working clause of a foreign patent law, has started a *bona fide* work shop to supply the market of the country governed by such law, and it stands to reason that in the great majority of cases it would be commercially much more rational to abandon the foreign patent and endeavor to maintain, without patent protection, whatever footing in the market had been gained."

As to the compulsory license provisions of Germany, Great Britain, and Canada, it is a well-known fact that up to the time of the outbreak of the European war, at any rate, they have not been applied. Dr. Osterrieth in his paper published in the Report of the Investigation of the United States Patent Office (1912, page 379), states that this clause in the German law proved most ineffective, "as no single case of revocation on this ground has been known." In Great Britain almost no applications have been made for compulsory licenses. There is no such case reported in the whole volume of the *Illustrated Official Journal* for the year 1909. Later reports show that the same state of affairs existed down to the outbreak of the European war. In Canada also no compulsory license has ever been granted.

One reason unquestionably is that without the free co-operation of the inventor and patentee, it is impracticable to operate under a license because of the difficulty of manufacturing on a commercial scale anything with the development of which one is not familiar.

There is another objection which is, I think, even more important. If a compulsory license provision is to be effective it means a new class of litigation respecting property which is almost fatally burdened with litigation under present conditions.

If it is not to be of any practicable effectiveness, it of course should be avoided. It will necessarily reduce the value of patents. The mere prospect of increased litigation would insure this result.

Moreover, the policy of compulsory license raises a question of the theory of compensation of patentees which I think will almost certainly result in great hardship. Let me cite, by way of illustration of my point, the famous drug known as "606." This number means that there had been 606 experiments, 605 of which failed to produce the desired result satisfactorily. This is an exaggerated case, doubtless, but it is characteristic of invention-development that the losses incident to failures which precede the final success are large.

Yet when the compensation of the patentee is to be determined, he must, in order to defend his property, present all of the failures and their bearing upon the development of the invention. The chances are far more than even that in the end the rule will be merely to grant fair compensation for the enjoyment of the final successful invention as if it had been struck off at a blow. It will certainly be very difficult to induce a court to grant return on what will be looked upon as junk.

* Address by the Hon. Thomas Ewing, Commissioner of Patents, before the American Patent Bar Association, February 20th, 1915.

## Dr. Rittman's Gasoline Process

SECRETARY OF THE INTERIOR LANE recently announced the discovery by the United States Bureau of Mines of two chemical processes, one of which, it is claimed, will be of tremendous importance to the oil industry, greatly increasing the supply of gasoline, while the other will give the United States the important materials necessary for the dye industry and the manufacture of high explosives used in warfare and in engineering operations.

The first of these processes promises to enable the independent refiners in this country to increase their output of gasoline from petroleum 200 per cent or more. With an estimated production on the part of the independent refiners of 12,000,000 barrels of gasoline in a year, this will mean an output from the independents alone of 36,000,000 barrels, greater than the total production to-day from all sources.

The second process includes the manufacture from crude petroleum of what is known chemically as toluol and benzol, both of which have heretofore been obtained from coal tar. As Germany has specialized far beyond other countries in by-products from coal, the United States and the rest of the world have been dominated by that country as regards those products of toluol and benzol which are the important bases for the production of dye stuffs and high explosives, and especially smokeless powder.

The discoverer of these two valuable processes, after many years of research, is Dr. Walter F. Rittman, chemical engineer of the Bureau of Mines, the work having been done at Columbia University, New York, the facilities of the laboratory there having been turned over to the Federal Government by President Nicholas Murray Butler.

It is claimed by Dr. Rittman that his process is safer, simpler and is more economical in time than processes now in use, and these are economic factors of great importance. With a steadily increasing demand for gasoline for automobiles, motorboats, and engines, this fortunate discovery comes at the proper time. It is but two years ago that the automobile industry, fearful that the supply of gasoline might not be adequate for its rapidly expanding business, offered through the International Association of Recognized Automobile Clubs, a prize of $100,000 for a substitute for gasoline that would cost less than gasoline. Happily the urgency of this situation has passed and at the present time there is a plentiful supply of motor fuel to meet immediate demand. This new process adds to the hope, that in spite of the wonderful growth in the use of gasoline, there may not be any shortage in the future. It indicates an increased production of gasoline from the present production of petroleum—an output of 50,000,000 barrels instead of 25,000,000, as under the present methods. It will render free for use to all, the results of that efficient and intelligent research which has heretofore been only at the command of the wealthy. When it is realized that the gasoline industry each year in this country yields products amounting in value to between $100,000,000 and $150,000,000, the importance of this discovery is seen.

Among necessary ingredients of high explosives used in modern warfare toluol and benzol are in the first rank. Heretofore these products have mainly been obtained in Germany and England from coal tar, and the explosives manufacturers have had to depend largely on the supply from these sources in the making of explosives. Some toluol and benzol have been obtained from American coal and water-gas tars, but this supply does not begin to satisfy the present demands. The Federal Government now proposes to obtain the toluol and benzol from crude petroleum also. These products can be produced from practically any American petroleum by the Rittman process, and the supply can be made sufficient not only for the entire American trade, but also for other purposes. This process has gone far enough to indicate that the two products can be produced at a reasonable cost.

Dr. Rittman concludes from his experiments that this process may become more economical than the German method of obtaining these products from coal tar, as this process not only makes toluol and benzol, but also gasoline in considerable quantities. He has intimated the possibility of the value of the gasoline being an important factor in paying the costs of the process.

## The Current Supplement

THE important subject of establishing a definite universal standard for determining horse-power and the making of accurate measurements of power is fully covered in the article on The Relation of the Horse-power to the Kilowatt in the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT, No. 2045, March 13th, 1915. The Rural School and the Hook Worm contains valuable information in relation to a subject of great importance. The Defense of Belgium by Inundation gives an interesting description of that portion of Belgium where the German advance was checked by the opening of the dikes. The Educational Scrap Heap is a most valuable discussion of one of the most important educational problems now confronting us. Gyrostatic Action describes a number of gyrostatic devices available for controlling moving bodies, especially as applied to aeroplanes, submarines, and automobile torpedoes. The use of a powerful electromagnet for removing particles of metal from wounds and the eyes describes an invention of great value both in peace and war. Deformation of the Earth by the Moon discusses a most interesting but difficult problem and some of the methods of solution. The consideration of police departments from an engineering standpoint is in the line of a more scientific and practical handling of criminal matters. The Strongest Vault in the World describes the remarkable structure that was installed in the new banking house of J. P. Morgan & Co. Theories about Thunder adds considerable information on a familiar subject. Some timely information in relation to trinitrotoluene, the explosive so largely used in military operations, and popularly known as TNT, is given in a short article; and there are notes on the comparison of the silver and iodine voltameters.

# Correspondence

*[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]*

## Why the Mail Bag?

To the Editor of the SCIENTIFIC AMERICAN:

The large amount of breakage and the needless crushing of many Christmas presents recently sent through the mail raises the question why the mail bag is retained by the Government. Express companies avoid much damage to packages by using common sense. Why should the Government retain this relic of the days of the pony-relay, this modified form of saddle bags?

Ferndale, Cal. A. G. GRANT.

## Watering City Trees

To the Editor of the SCIENTIFIC AMERICAN:

In your issue of December 12th appeared a description of a novel contrivance which is being used in Strassburg, Germany, for applying water to city trees in dry seasons. The method therein described—of bending a perforated iron pipe around the tree to be watered and then attempting to saturate the hard ground sufficiently for the needs of a large tree, by means of pouring water into a funnel and thence into the bent and buried pipe, pierced with small holes—all appears to be a most impractical and expensive method. Your correspondent has often had occasion to apply water to planted trees in an arid climate and he has been uniformly successful with the simple expedient of boring one or more holes with a post auger (avoiding all large roots) at a suitable distance from the tree, say 18 inches more or less, according to its age, and to a depth of 2 to 3 feet. These holes, if more than one is deemed necessary, should encircle the tree equidistant and be tamped full of horse manure mixed with light stable litter, which will be found to take up water by the bucketful as fast as it can be poured thereon, fertilizing and softening the ground all around the roots and retaining the moisture for a long time. A dab of hay can easily be added on top of any hole where settling takes place. By this means the roots will also receive an increase of moisture during rainy seasons.

Lawrence, Kan. M. SHILLERSTON.

## Resin and Babbitting

To the Editor of the SCIENTIFIC AMERICAN:

Here is something that you probably know all about, but I know that a great many others do not, and to such it may be of great value, save time, and possibly prevent some serious accidents. As safety first is the great cry now, I give it to you either for publication or the waste basket, as you may deem fit.

While working on my first job as a millwright I had occasion to run some small boxes with Babbitt metal. In running one of them, when nearly full the hot metal exploded and I came near losing one of my eyes. Just then the boss millwright came around and said the cause was that there was water in the box. "And now remember as long as you work at this business that you can't run hot metal into a wet or damp box; it must always be absolutely dry or you run a great risk."

I remembered that advice and acted upon it for many years until I had all my knowledge knocked out of me by another who was not a boss.

On the last sawmill that I helped to build I was running some boxes and one of them happened to be right under the eaves, and it was a rainy day; I put a cover over the box, but the water would spatter in, and I did not dare to try to run it. I told the Dutchman that was working with me that we would have to leave that till some other time, for it could not be run. He said, "You run over to the store and get some resin and I will show you that we can finish the job now." I got the resin: he crushed some of it with his hammer and put it in the box that was now good and wet and said, "Now pour in your metal." This I refused to do. He took the ladle and turned in the metal, while I stood well out of the way. There was no sign of an explosion; not even steam. Since then I have run many, even if half full of water; put a little powdered resin on top and there is no danger of explosion. What is the reason? J. F. MILES.

Wisconsin Veterans Home, Wis.

## Uncle Sam's Real Need

To the Editor of the SCIENTIFIC AMERICAN:

Your discussion of our military needs is extremely timely. The trouble is our extremists. One side clamors for "universal" military training or "the biggest navy in the world." The other side, with almost equal absurdity, deprecates any increase whatever. And the truth lies, as so often the case, about half way between.

Why emphasize a trained reserve of half a million? Simply because it goes straight to the point of vital need. For with such a force a serious naval defeat would not spell terrible disaster. As it is now, we've got practically nothing to back our navy up.

What do your pages, and those of your contemporaries, indicate as the probable size of an invading host in case of naval defeat? From 100,000 to 150,000 men, or a possible 200,000. But what could they *accomplish* if we instantly mobilized 500,000 to confront them, thoroughly trained for a year, say 50,000 a year till the total was reached?

Thereafter we would only have to keep the quota full and allow a fortnight for annual maneuvers, so officers and men might march and deploy in masses of one or two hundred thousand, in which, with our present corporal's guard of an army, they can have no training whatever.

We don't want a standing army, for reasons too familiar to mention, and we don't need the proposed three years training. With volunteers of the right stamp and training, one year will suffice.

On the other hand, we *do* require a force of the size stated, for the reason stated. We don't like the spirit of militarism. But if those 500,000 developed too much of that spirit there are already about 99,500,000 more of us to keep them in check. And there'll soon be several more. Besides, that reserve would not be a standing army, but merely a national guard to serve in case of foreign war, and, primarily, to repel invasion.

The other needs of the service, perhaps important but minor needs, will tend to take care of themselves, if we only meet the paramount need above referred to.

San Francisco, Cal. A SON OF UNCLE SAM.

## Why Ice, in Refrigerators, Prevents Freezing

To the Editor of the SCIENTIFIC AMERICAN:

This problem was presented to my attention, the past winter, during a severe cold wave, which occasioned comment upon the matter of heat conservation.

At a recent convention held in Chicago the question arose as to why was fruit frozen in cars containing no ice, while in those containing ice, fruit was not frozen, even when the temperature was much below the freezing point.

That such results were literally correct was verified by many experiences, besides confirmed also, in a domestic way, as the freezing of contents in ice boxes when they held no ice, while when ice was stored in the box the contents remained unfrozen.

The industrial importance of such natural law will readily appear. I therefore advance an explanation which I feel satisfied will justify its acceptance.

The Chicago convention above mentioned failed to elucidate the matter, hence, as it was still a mooted question, I essay an answer.

In the first place, we recognize the physical fact that ice registers 32 degrees of heat, while all degrees below 32 degrees must obviously be colder and thus liable to freeze any body containing water in its substance. Thus, we get frozen vegetables and fruit in cars lacking ice when the temperature drops any considerable degree below the freezing point, whereas if ice is stored in that same car the fruit and vegetables are not frozen.

This, then, being true, we are confronted with the explanation which I wish to advance, viz.:

In the car containing ice the chill of the air is neutralized by the action of the ice when the temperature drops below that of the ice. This results from the release of latent heat as a result of congelation of vapor contained in the air, while the resultant ice, formed out of the vapor, will precipitate itself upon the ice just as rapidly as it reaches that body of frozen water; thus when the fresh ice is formed there is likewise a release of the latent heat of the vapor, amounting, at steam heat, to 536 degrees. Thus the air of the car is kept warm by the latent heat given up by the action of its contained ice upon the vapor carrying such hidden heat. This latent heat, thus released, is the warming agent which preserves vegetables and fruits from freezing in cars or refrigerators containing ice. The fruit and vegetables, while largely water, yet being in the form of organic compounds, will freeze at a lower temperature than pure water. JOHN D. BONNAR, M.D.

Buffalo, N. Y.

## Integral Salts for Cold Weather Concreting

To the Editor of the SCIENTIFIC AMERICAN:

In the issue of the SCIENTIFIC AMERICAN for December 5th, 1914, there appears under the heading "Concrete Freezing" some statements covering the use of concrete in freezing weather, to which I should, in part, like to take friendly exception.

While it is true, as your writer says, that the use of chloride of calcium added to the mixing water will prevent the freezing of freshly deposited concrete, nevertheless the use of this substance, as well as the use of chloride of sodium, is not to be recommended for a number of reasons, and modern practice in cold weather concreting has so far recognized the validity of these reasons as to have practically ceased the use of integral substances for the purpose mentioned. Your writer says:

"It is a well-known fact that solutions of different salts are more difficult to freeze than pure water; for instance, a 20 per cent common salt solution only freezes at 14 deg. Cent. below the freezing point of water and a chloride of calcium solution freezes at a still lower point, or 18 deg. Cent. below. This phenomenon can be made use of in connection with concrete working, and such solutions are used when preparing the material so as to lower the freezing point. In this way it is possible to carry out work with concrete even during very great cold which would not be practicable by the ordinary process."

Experience seems to have proved that there is a practical limit to which chloride of sodium and chloride of calcium may be used, as an excess of either of these materials will affect the ultimate strength of the concrete. This limitation has made it impracticable to rely on chemical salts as a preventive of freezing for temperatures lower than 22 deg. Fahr. Hence, you can see the use of chemical salts does not, as your writer states, make "it possible to carry out work with concrete even during very great cold."

Your writer also says:

"It is better to use chloride of calcium instead of common salt for such work, as the former salt increases the waterproof quality of the concrete and is much preferable for this reason."

And further:

"Adding more than 2 per cent of salt (chloride of calcium) is found to increase the speed of setting, but it is remarked that concretes are less resistant as the setting is quicker, so that it is not well to go higher than the foregoing figure."

This last supports what I have already cited by way of objection.

Concerning the subject of increasing the watertightness of concrete, authorities now generally agree that the subject of watertightness is one largely, if not entirely, dependent upon proper grading and proportioning of aggregates combined with the proper proportion of cement, materials being mixed with enough water so that the resultant mass is of a so-called "quaky" consistency, meaning that there is just enough water to permit placing the concrete with slight puddling rather than tamping, yet not enough water to cause the sand-cement mortar to separate from the coarse aggregate.

By far the best precautions to use in cold weather concrete work consist of heating the materials used (excepting the cement) and protecting the concrete from freezing for a certain time after placing. Chloride of sodium and chloride of calcium used in safe quantities retard rather than hasten the hardening of concrete, while in winter work methods which will accelerate the hardening process are to be sought and practised.

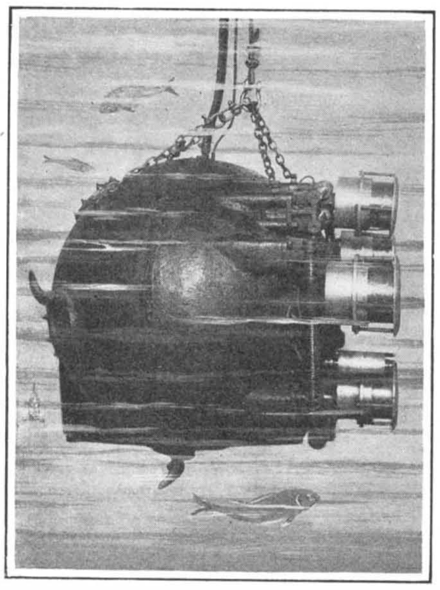
As water is an element required to bring about the hardening of Portland cement, it is evident, first, that the water in concrete must be kept from freezing; as heat also hastens the hardening, it is evident that warmth is desirable. This suggests heating the mixing water to a temperature of at least 150 degrees, likewise heating the aggregates and mixing the heated materials so that the concrete when placed shall have a temperature not lower than 80 degrees; then at once providing suitable protection for the freshly deposited concrete so as to maintain as much of this added heat as possible for at least a 48-hour period. During this time, under suitable protection, the concrete will have hardened sufficiently to be proof against injury from possible freezing thereafter.

There are other objections that condemn the use of chemical salts. First, we may consider the trouble of efflorescence, otherwise described as "a whitish deposit appearing on the surface of concrete work and consisting of a substance principally free from lime carbonate." This results from the absorption of rain or moisture by porous concrete and the dissolving out of any solution salt present, which subsequently is deposited on the surface when evaporation takes place. Both sodium chloride and calcium chloride, being very deliquescent salts, will aggravate the trouble of efflorescence.

Second, recent investigations conducted by the Bureau of Standards, Washington, D. C., and contained in Technologic Papers No. 18, agree with general experience that salt and calcium chloride are especially objectionable in reinforced concrete work. Both act to corrode reinforcing metal and both increase the electrical conductivity, which is objectionable if the structure is likely to be subjected to the action of electric currents, in which case electrolysis might be set up, with eventually serious results.

We trust that the information we have volunteered will be of interest to you and possibly of interest to your readers. In either case you are at liberty to make such use of it as you see fit. We shall appreciate having you consider at any time that a part of our efforts can be drawn upon in the best interests of any use of cement or concrete, and we shall be glad at any time to have you make use of any such service we can offer.

Chicago. WILLIAM M. KINNEY.



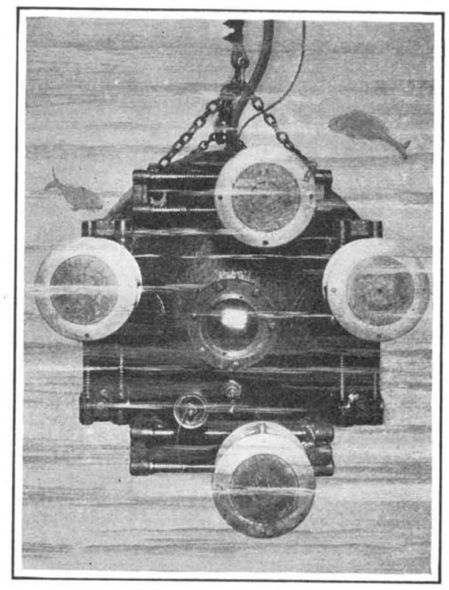
Lowering the spherical submarine.

# In Quest of Sunken Treasure

## Spherical Car for Deep Sea Salvage Work

By C. L. Edholm

*[Interest in this deep-sea salvage device lies chiefly in the fact that it has actually been built. But what will it ever do? It is no small task to lower pontoons of size sufficient to raise even a small steamer. Then, assuming that the ship is not buried in mud, comes the difficulty of attaching them in such a way as not to tear the ship's plating off. Finally, even with pontoons on the surface, the greatest difficulty is experienced in raising a vessel with such even tension as to prevent the chains from snapping, one after another, and plunging the vessel to the bottom again. Only an experienced wrecker realizes the enormous weight and extreme frailty of an ocean steamer.*—EDITOR.]



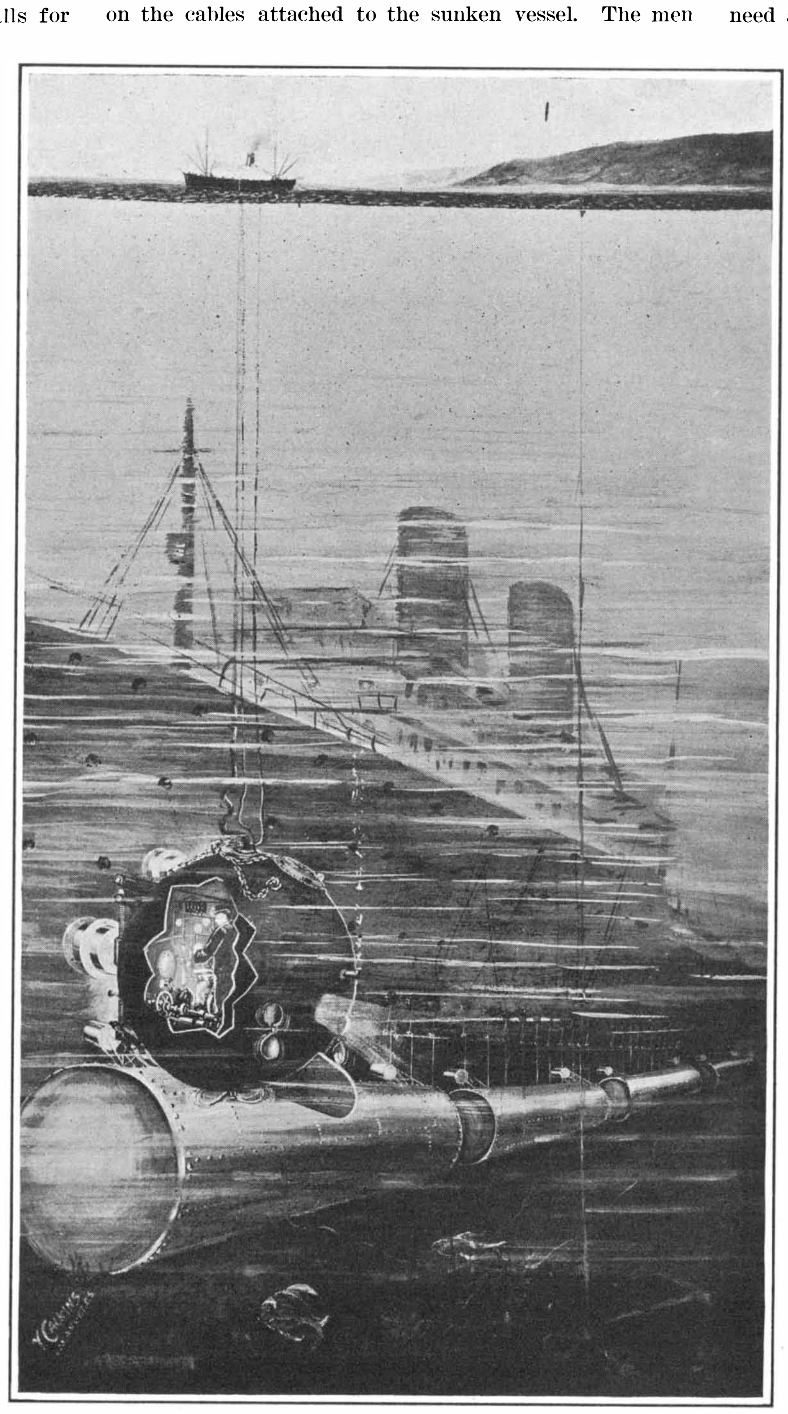
The four adjustable electro-magnets.

THE sea is full of gold, not only in chemical solution, but also in real coin, dollars, double eagles, pounds, Napoleons, doubloons, talents, shekels. It is all there, with vast quantities of bullion and other treasures untold, the tribute that the old pirate Neptune has exacted from man through the long centuries since the first mariner ventured forth in his rough log boat. We could better endure the annual levy were it not hoarded like miser's gold, never to be put into circulation again; and so we find men ever scheming to penetrate the treasure vaults of the deep and recover some of the rich plunder. The latest scheme calls for the use of an armored car—armored against the enormous hydraulic pressure with which old Neptune tries to crush those who would venture deep into his domain. In order to make it a particularly hard nut to crack the car is made in the form of a sphere. This car has actually been built, as our photographs show. Needless to say, the picture of the car at work is drawn from pure imagination and represents the inventor's dream of what he expects to do at depths below the reach of the common diver.

The device, it will be seen, has some of the features of a diving bell and some of a submarine boat. Like the diving bell, it is connected by chains and cables to a tender ship, from which it receives electric current to operate a powerful motor. The sphere is a metal shell an inch and a quarter in thickness, is equipped with two propellers on universal joints, and these enable it to cover a wide radius at the end of its cable, so that when the device is lowered at the approximate location of a wreck, it can search for it if not immediately found. It carries a searchlight, which may be directed over the bottom from the submarine, and by a telephone system the tender is instructed to change the position of the sphere as required. Two men are carried in the sphere to operate its motors and to communicate with the vessel above.

Here is the plan of procedure as mapped out by the inventor, William D. Sisson, of Los Angeles:

When the wreck is located, the submarine car ascends to return with a pontoon of corrugated steel, which is equipped with an electrically operated pump. The pontoon is sent down filled with water, and when attached to the side of the wreck, the water is pumped out by current from the tender. The pontoon also carries a number of cables, and at the end of each is a float and a pontoon hook. If the wreck is of iron or steel construction the method of attaching the pontoon is as follows: The submarine is furnished with four electro-magnets which exert a pull of many tons when energized. The car approaches the hulk, an operator throws on the current, and the sphere is firmly clamped to the wreck. Then an electrically driven drill which is placed between the four magnets bores a hole in the side of the hull and the sphere is shifted a few inches without releasing the hold of the magnets. Meanwhile the pontoon has been set in position below the sphere, with its pontoon hooks supported by floats within a short distance. When the hole has been drilled to receive it, a hook is seized by a magnetized arm and inserted in the side of the vessel, a spring catch prevents it from slipping out, and the sphere is then shifted a short distance and another hole drilled in the wreck. This operation is repeated until a sufficient number of hooks are inserted, after which the submarine ascends once more to bring down another pontoon. The number and size of pontoons used varies according to the size of the wreck, of course. When the required number have been attached to the wreck, the electric pumps in the pontoons are set in operation from the power plant in the tender ship and the water is gradually forced out, until as they become buoyant, they exert a pull on the cables attached to the sunken vessel. The men in the submarine are able to observe this operation and control it by ordering pumps on one side or another to be operated, so that the hulk can be brought up on an even keel. By continued pumping, the pontoons finally succeed in floating the wreck to the surface, after which the tender can tow it to the most convenient port or drydock for salvage.



Attaching air cylinders to a wreck.

### A Children's Museum

TO the Brooklyn Institute of Arts and Sciences, Brooklyn, N. Y., is due the credit for the establishment of what is said to be the pioneer "Children's Museum" in the United States. Boston has been quick to recognize the moral and educational value of the newest juvenile institution, and has just founded its own museum for little folk.

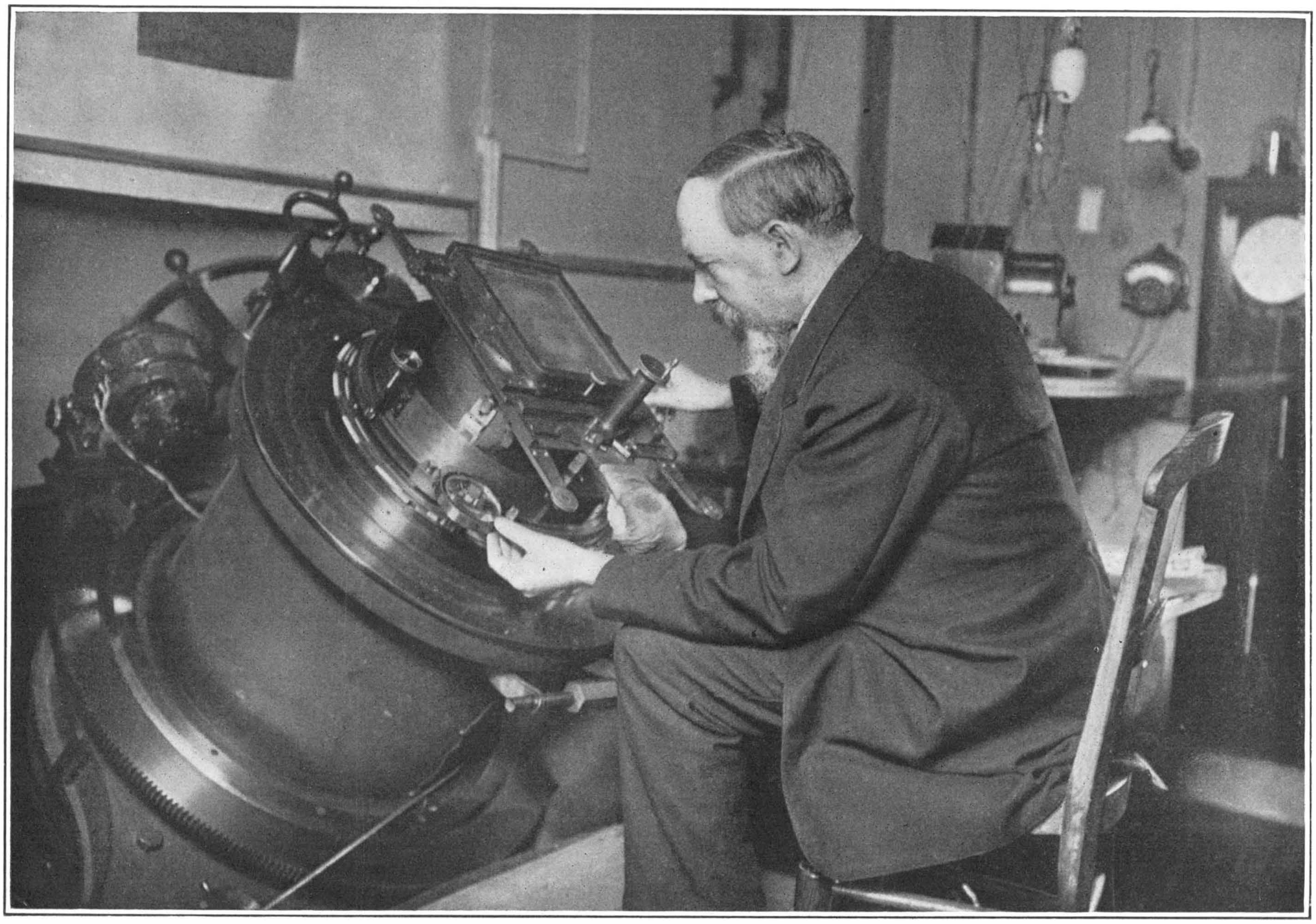
In the Brooklyn Children's Museum, in Bedford Park, that city, it is the constant aim of the members of the staff to see that its little visitors find what they need and want. A docent has been appointed, in addition to the regular assistants, so no child need wander aimlessly about the rooms. At all times the permanent collections of specimens, charts, and models may be viewed, and schools are invited to use the museum as often as may be desired, either by the visit to the building of classes or by having small collections sent to the schoolroom or assembly hall.

At certain times there are special items of interest. Just now Miss Gallup, the curator, is planning a bird calendar, which will be, as its name suggests, a memorandum for the year of the birds of the region about Brooklyn and Long Island. Under each month there will be listed the birds seen in Prospect Park, the popular playground of the "City of Churches," during that period. In this way the "feathered folk" that abide permanently in the neighborhood, as well as those migrating in the spring and fall, can be studied. Models for this collection are now in preparation.

An interesting addition to the museum's department of geography is also under consideration. It will comprise five groups showing primitive peoples in the zone belts. It is doubtful if a better way than this could be devised to illustrate in a pictorial manner the life of man in relation to his environment.

The models will be accurate to the last detail, and will be rendered specially suggestive to the impressionable child-mind. The first grouping already is completed and has been passed upon by Mr. Miller, who was with Col. Roosevelt on his last exploring expedition in South America, and also by Mr. Hornaday, director of the New York Zoological Society. This represents life in the neighborhood of the Amazon River, centering about a Carib Indian. These, together with the history models prepared by Miss Agnes E. Bowen, will, when completed, form a valuable and attractive educational exhibit that should be utilized freely by teachers.

**Typhoid in the British Army.**—The latest illustration of the beneficent effects of antityphoid inoculation is the statement made to the House of Commons on February 8th by the British Under-Secretary of State for War that only 421 cases of typhoid had occurred in the British forces during the present campaign, and of these 305 cases were in men who had not been inoculated within two years. Among the men who had been inoculated there was only one death, and this was of a man who had received only one inoculation instead of the regular two. *Nature* compares this record with that of the Boer War, when the British had 58,000 cases of typhoid, of which 8,000 terminated fatally.



The eye end of the equatorial coudé at the Paris Observatory, arranged for making a photograph.

# The Paris Observatory and Its Work

## The History of a Famous Institution

By Prof. George A. Hill, U. S. Naval Observatory

IN the southern portion of the city of Paris is the National Astronomical Observatory of France. The extensive grounds in which the buildings used in astronomical research are located is bounded on the south by the Boulevard Arago, named after one of the brilliant directors of the Observatory who filled that office from 1811 to 1853.

The Observatory faces toward the north, and entrance is by way of the handsome Avenue de l'Observatoire, that leads directly to the garden and palace of the Luxembourg. At the approach from that side is a high iron fence, with a watchman's lodge on the left. The gate is always closed, and admission can be obtained only if the visitor is known to the watchman.

Passing the gate, the first object to catch the eye is a life-size monument to the memory of Urbain Jean Joseph Le Verrier, one of the illustrious directors of the institution, who filled that office from 1854 to 1870 and from 1873 to 1877.

Many are familiar with the mathematical knowledge possessed by Le Verrier, for it was his profound study, carried on at the same time by Adams of England, that designated the place in the heavens toward which the astronomer should point his telescope to discover Neptune, the outmost planet of the solar system.

The main building, which was built 1667-1672, is in the side of a hill, and antedates the Greenwich Observatory by a few years, the first stone for which was laid in the late summer of 1675. It also antedates the Royal Observatory at Berlin.

Entering the building, the visitor passes through a long hallway and then ascends a stairway to the floor above, where are the offices of the director, astronomers, assistants, computers, and the museum. This floor is at the height of the terrace of the grounds, and on the south are the beautiful gardens of the Observatory and a number of isolated buildings containing various astronomical instruments.

Attached to the institution, now over two hundred and forty years old, is a museum of great astronomical and nautical interest. In it will be found a sextant made by Langlois in 1750. In astronomical instruments the mural circle made by Bird in 1774 would immediately attract attention. It was used at the observatory of the military school at Paris from 1778 to 1785. The early history of the instrument dates back to our first knowledge of the positions of the stars in the heavens. With this mural circle, Lalande, from 1789 to 1799, made 50,000 star observations. It was used by Burckhardt from 1803 to 1825, and by Damoiseau from 1825 to 1834. It has been truly said this mural circle was the astronomical instrument that first gave a detailed representation of the stellar heavens.

It would consume too much space to describe all the instruments and articles of historical interest to be seen in the museum, but mention may be made of the first Fresnal lighthouse lens, made by Soleil. On the walls are paintings of the portraits of famous astronomers of all ages, photographs of interesting stellar and planetary objects, and large celestial globes of the sixteenth century stand on the floor.

At the extreme western end of the building are the dwelling rooms of the director of the Observatory, Dr. Baillaud. At the eastern end are the meridian observing rooms. The upper stories are used for computing and storerooms, while above these are a number of domes which contain equatorial telescopes.

Previous to 1863 observations of the meridian transit of the sun, moon, planets, and stars had been made with two instruments, namely, a transit and a mural circle, one for observing the right ascension of the object, and the other its declination. In that year, from specifications prepared by Le Verrier, M. Eichens constructed the large transit circle that is shown in the photograph, which is mounted in an east wing of the Observatory.

The building stone that was used in the past in the construction of the many handsome edifices in Paris was taken from practically beneath the city or its immediate vicinity. These excavations produced the huge subterranean chambers that have been called the catacombs.

Under the Paris Observatory is a pronounced instance, and the standard astronomical clock of that institution is located in a cellar, eighty-four feet beneath the surface of the ground. The temperature of the air at that depth is practically constant for the whole year, and advantage was taken of that condition to install the standard clock here. The location is nearly ideal, for the writer from personal use of the clock, in a series of astronomical observations, has found its daily rate to be as small as from two to three hundredths of a second of time.

The pier upon which the large transit circle is placed is of very solid construction. The foundation is a monolith, over six feet thick and sixteen feet high, extends the entire length of the observing room north and south, and terminates in the upper terrace of the grounds. This foundation was constructed two centuries ago, of an excellent material, and the whole mass forms a solid wall upon which are placed two upright piers to support the transit circle. These piers are also huge masses of stone.

The body of the telescope is of cast iron. Four of the sides of a cube form the points of attachment for the tube and axis. The length of the two truncated cones are unequal, that carrying the object glass being the longer.

As is shown in the illustration, the piers which support the instrument are unequal in height. The east pier, the one on the right, is nearly a meter higher than the other. The object glass, made by M. Secretan, is 9.3 inches in aperture, and the focal length of the instrument is 12 feet 8 inches.

There are two divided circles on the instrument, one for measuring the angular distance of a celestial body from the zenith, and the other for approximate setting purposes. Both of the circles are fastened to the eastern side of the cube of the transit circle. The outer one, which is hidden by the high pier, is made of bronze one meter in diameter, and the silver band on its circumference is divided into five-minute spaces.

The inner circle, which shows in the illustration, is made of cast iron, and is 1.20 meters in diameter. On it the divisions are not as fine as those on the other

(Concluded on page 255.)

# The Heavens in March

## Measuring the Distances of the Nearer Stars

By Henry Norris Russell, Ph.D.

THE enormous distances of the stars have long been a theme of general interest. Even the nearest of them are so far off that it is harder to get a real conception of the relation of their distances to those with which we ordinarily have to deal than it is nowadays to measure the stellar distances themselves.

It is easy enough to say glibly that the very nearest star is 25 millions of millions of miles away, but we may understand better what our words mean when we realize that, could some one be set to count these miles, one by one, at the rate of 200 per minute, it would take him 240,000 years, working night and day without a moment's rest, before the tremendous task was completed.

The distance from Earth to Sun—the "astronomer's yard-stick" as some one has called it—is relatively insignificant; our imaginary teller could count the miles composing it in a little less than eleven months, if he never stopped to rest.

Let us start now with this distance, and make a map on which it corresponds to one inch, or, rather, a model, since if we are to put the stars on it in their correct positions it must extend in all directions in space from its center, and not in a single plane. The Sun, on this model, will be represented by a ball 1/110 of an inch in diameter—a small grain of sand. The Earth, which is a hundred times smaller, would be hardly larger than a microbe. The stars, like the Sun, would be represented by grains of sand of various sizes; and the speck which represented the nearest one would be more than four miles from the particle which stood for the Sun.

Somewhere between fifty and a hundred stars would be found on our model within twenty miles of the Sun; all the rest of the millions which are known would be farther away. How much farther? This is one of the great questions whose answer is just beginning to come into sight. In describing these great distances it is convenient to use as our unit the distance which light travels in a year, called for brevity a "light-year," which corresponds almost exactly to one mile upon the scale of our imaginary model of the universe.

The nearest star is then between four and five light-years from the Sun. By direct methods we can measure distances up to about 100 light-years, and from a study of the motions of the stars we can estimate the average distances of groups which in some cases are 500 and even 1,000 light-years away. Some of the stars visible to the naked eye and very many of the telescopic stars must be beyond even that limit. We know, however, that space is not thus filled with stars forever, for, if it were, the number of faint stars visible in great telescopes would much exceed that which is observed. Ultimately, the stars must "thin out"; that is, at sufficiently great and increasing distances. They must be more and more sparsely scattered in space. How far would we have to travel before we found this to be the case?

A partial answer has been given by certain work of Hertzspring, and also by Shaply and the writer upon variable stars. In certain cases it is possible to estimate from the details of the variation of a star's light, how big and how bright the star actually is. These estimates cannot as yet be made very precise, but are probably fairly trustworthy. By comparing the brightness with which the star appears to us to shine with the calculated brightness which it would exhibit if at some standard distance, the actual distance of each of the variable stars under consideration can be estimated. Hertzspring's results deal with the "short-period" variables (of which the well-known star Delta Cephei is the type) and the writer's with the eclipsing variables, such as Algol. In both cases the calculated distances of most of the stars are enormous. Not a single one of the 157 variable stars is within 100 light-years of the Sun, and only five—including Algol, Beta Aurigae, and Polaris—are within 200 light-years.

Almost half of the eclipsing variables and three quarters of those of the short period, or "Cepheid" type, are more than 2,000 light-years distant, and a considerable number are more than twice as remote.

In this way, which enables us to study stars which, though they appear very faint to us, are really of great luminosity, we can sound the depths of space farther than by any other method yet known. Examination of the results reveals the striking fact that all the remoter stars in the list are situated in the heavens close to the Milky Way. There are some stars among those studied which (as we see them) lie in parts of the sky remote from the Galaxy; but these are all relatively near us; that is, they all belong to the nearer half of the whole group.

This is one more confirmation of the old belief that the region of space within which the stars are scattered extends much farther in the direction of the Milky Way than at right angles to it; but the present method of attack has the advantage that it makes possible a rough estimate of the actual size, or, at least, of the actual thickness of this vast cluster of stars.

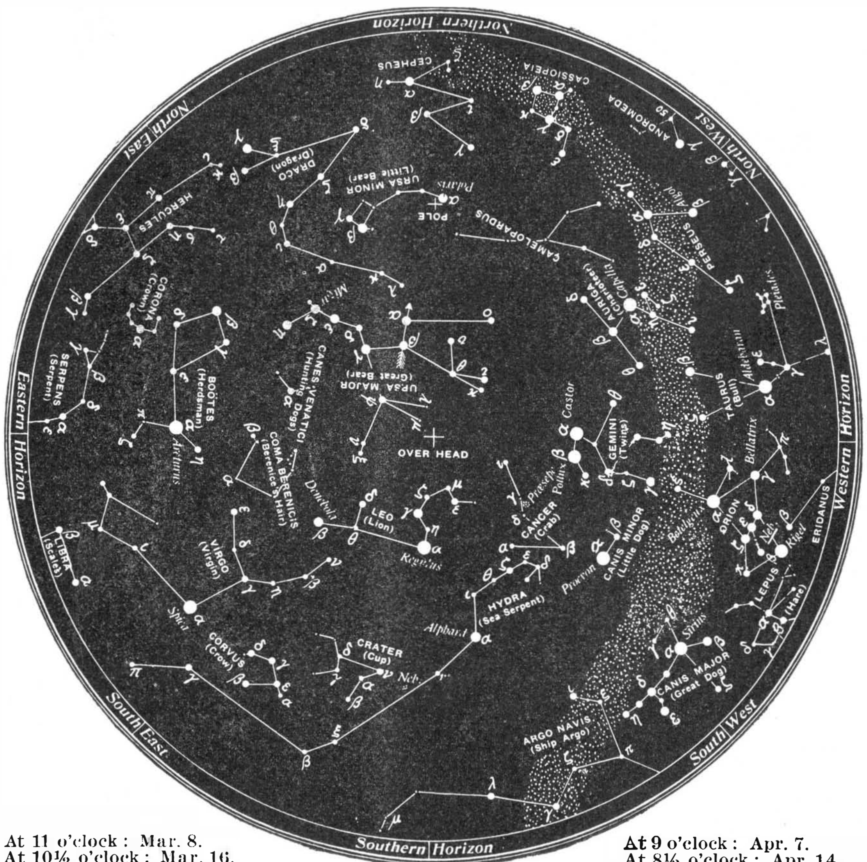
If we draw a plane through the Sun extending in all directions toward the central line of the Milky Way and calculate the distances of our variable stars above or below it, we will find that the average for the whole 157 is but 360 light-years—a small fraction of their average distance measured parallel to the plane, which is 3,100 light-years.

Seventy-eight per cent of these stars lie within 500 light-years from this plane, and only 8 per cent of them are more than 1,000 light-years away from it on either side, the greatest distances being about 1,600 light-years.

There is no known reason why stars at a greater distance in this direction should not be as easy to see as those equally remote in the direction of the Milky Way, and the fact that we do not see them indicates that they are not there; at least in any considerable numbers. We may, therefore, say: The large majority of the stars accessible to this powerful method of investigation lie in a layer about 1,000 light-years thick, which extends in all directions toward the Milky Way for several thousand light-years.

Outside this layer the stars thin out very rapidly on each side, while along the layer toward the Milky Way there is as yet no evidence that our soundings have struck bottom. The Sun is nearly, but not quite, in the middle of the layer, the evidence showing that it is about 100 light-years to the northward of the central plane.

All this is based on the assumption that the starlight traverses even these enormous distances without perceptible loss. If we assume, as some astronomers have done, with considerable reason, that there is some loss of light by absorption in space, we will get smaller dimensions for the vast star-cloud of which our Sun is a member; but no reasonable assumptions will make it less than 600 light-years in thickness (not counting the outliers on each side) and 6,000 light-years in diameter. The extension of similar studies to fainter stars may make it possible before long to set some limits to the extent of this vast swarm of stars in the direction of the Milky Way. In any case, we know that there are other star-clouds outside it, for in the southern heavens are two patches of light far from the Milky Way, but looking like portions of it, which are known as the Magellanic clouds, since they were first noticed by the great navigator. These are full of variable stars, and Hertzspring, applying his method to the smaller of the two clouds, computes for it the enormous distance of 30,000 light-years. At such a distance the Sun would be invisible in the greatest telescopes ever constructed, though it might perhaps be photographed with a very long exposure.




At 11 o'clock: Mar. 8.
At 10½ o'clock: Mar. 16.
At 10 o'clock: Mar. 23.
At 9½ o'clock: March 30.
At 9 o'clock: Apr. 7.
At 8½ o'clock: Apr. 14.
At 8 o'clock: Apr. 22.

NIGHT SKY: MARCH AND APRIL

### The Heavens.

The finest region of the evening sky is the southwest, where we find Orion flanked by Taurus on the right and Canis Major on the left, with Gemini and Canis Minor above him. The southern sky is relatively dull, the most conspicuous constellation being Leo, high toward the zenith. The huge length of Hydra is now fully displayed. The monster's head, marked by a rather conspicuous group of stars of the third and fourth magnitudes, is about half-way between Regulus and Procyon. The isolated bright star Alphard marks its heart, and the sweeping curve of its tail extends far eastward and southward to the horizon under Virgo. In the southeast we find the small but prominent quadrilateral of Corvus, whose two uppermost stars point straight toward the brighter Spica in Virgo. Arcturus is resplendent in the east, with Corona and Hercules below and farther north. Draco and Ursa Minor are on the right of the pole, Cepheus below it, Cassiopeia below on the left, and the Great Bear high above it, extending to the zenith. Perseus and Auriga in the northwest bring us back to our point of departure.

### The Planets.

Mercury, Venus, Mars, and Jupiter are all morning stars throughout March. Mercury is best visible in the latter half of the month, during which interval he rises between 5 and 5:15 A. M. He is in Aquarius, not very far from Jupiter, but rises the first of the two. On the 29th the two planets are in conjunction and little more than a degree apart, while Mars is but 3 degrees above them. Jupiter is the brightest of the three, appearing about equal to Sirius. Mercury resembles Arcturus in brightness, while Mars is hardly superior to the brightest stars of the Dipper.

Venus, too, is a morning star, rising between 4 and 4:30 A. M., and far exceeding the other three in brilliancy. Mars can only be well seen during the latter part of the month, and this is even more true of Jupiter, who is barely past conjunction. On the 23rd these two planets are only one fifth of a degree apart, but, unfortunately, both are too low in the sky to be easily seen before the day breaks.

Saturn is in quite a different part of the sky, being in quadrature west of the Sun on the 17th, and best observable in the evening.

Uranus is a morning star, and may be easily picked up on the 19th, when he is 1 degree 10 minutes south of Venus.

Neptune is in the borders of Gemini and Cancer, visible until about 3 A. M.

The Moon is full at 2 P. M. on the 1st, in her first quarter at 7 A. M. on the 8th, new at 3 P. M. on the 15th, in her last quarter at 6 P. M. on the 23rd, and full again at 1 A. M. on the 31st. There are thus two full moons again this month, though there was none in February. The moon is nearest us on the 5th, and remotest on the 21st. She is in conjunction with Venus on the 11th, Uranus on the 12th, Mercury on the 13th, Mars and Jupiter on the 14th, Saturn on the 23rd, and Neptune on the 25th.

At 11:43 A. M. on the 21st the Sun crosses the celestial equator, returning to the northern hemisphere and "spring begins."

### Mellish's Comet.

A small bright comet was discovered by Mr. John E. Mellish of Cottage Grove, Wisconsin, on the morning

(Concluded on page 255.)

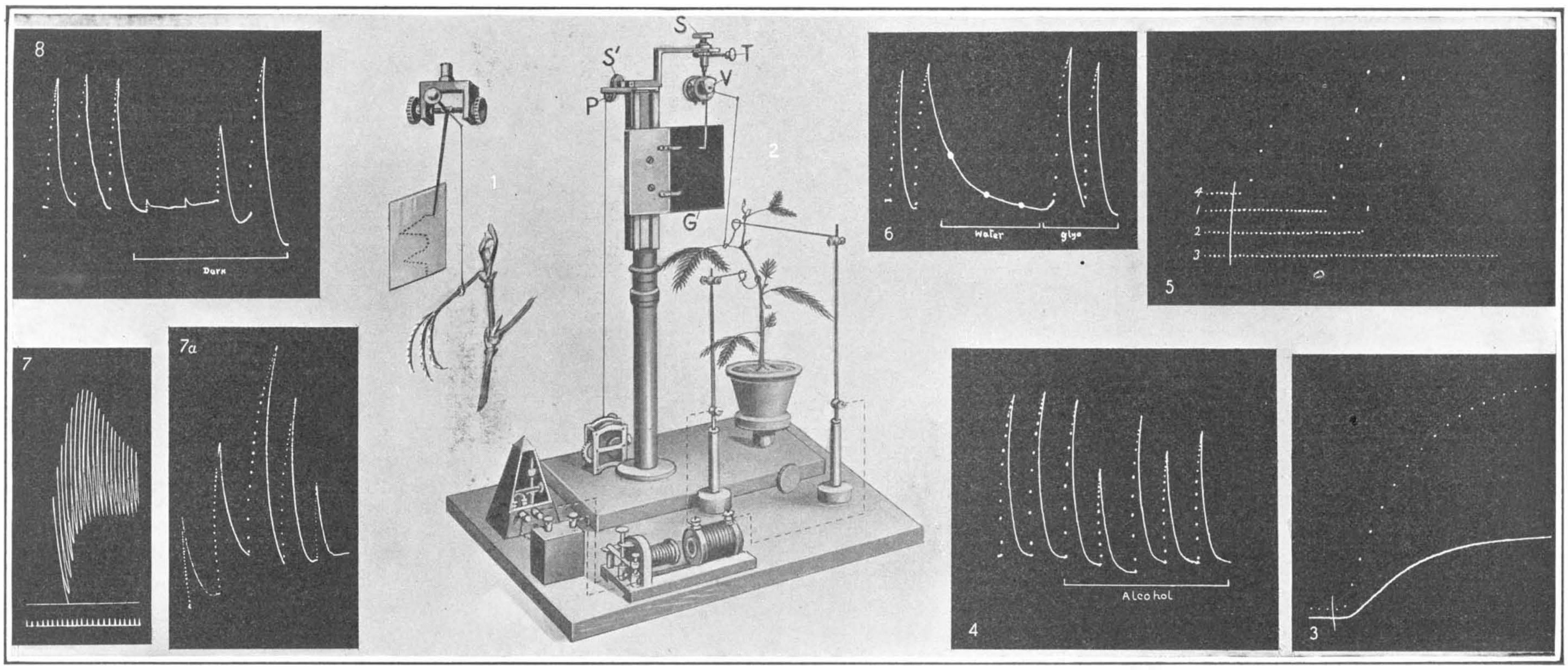



Fig. 1.—The essentials of a response recorder. Fig. 2.—General view of the resonant recorder. The thread from the clock passes over the pulley *P*, so as to lower the smoked recording plate *G*. The writing point is adjusted for distance by the screw *s'*; vertical adjustment is effected by the screw *S;* in order to adjust the plane of the recorder's movement parallel to the writing surface, a tangent screw *T* is provided. The picture shows also the electrical connections by means of which an excitatory shock of definite duration may be given to the plant by metronome which completes electrical circuit. Fig. 3.—The dotted line is correct, the continuous line incorrect, thus showing the advantage of intermittent over continuous contact in obtaining records. Fig. 4.—The effect of alcohol vapor; note the alternating character of the response after application. Fig. 5.—Effect of cold in inducing retardation and arrest of transmission: (1) normal record; (2) retardation due to slight cooling; (3) arrest of conduction brought about by intense cold; (4) record of direct stimulation. Fig. 6.—Effect of excessive absorption of water; note the prolongation of the period of recovery and the ineffectiveness of stimuli applied at moments marked with thick dots and subsequent restoration of excitability by application of glycerin. Fig. 7 and 7a.—Preliminary staircase followed by fatigue in the response of frog's muscle (Brodie) and staircase response followed by fatigue in Mimosa (Bose). Fig. 8.—Effect of sudden darkness on the excitability of Mimosa; first three responses normal; four succeeding responses due to the effect of darkness; the line below indicates the period of darkness.

# Plant Autographs and What They Mean

## An Investigation Which Proved That Plants Have the Same Sensations as Animals

WHAT is it that distinguishes a plant from an animal? It is response to excitation, pleasant or unpleasant, to all intents. Strike a dog and he will wince with pain. Strike a tree or a bush, and it remains imperturbable. To be sure there are "sensitive" plants, like Mimosa, which close their leaves when touched, but no biologist would dream of pain in that connection. In other words, a plant seems to differ from an animal in a total lack of psychological response to the outer world. Even the automatic action of Mimosa has been attributed to hydromechanical and not to excitatory causes.

These well-established conceptions of plant life have been completely upset by the remarkable experiments conducted for many years by Dr. Jagadis Chunder Bose, a professor of Presidency College, Calcutta. After lecturing in England before the Royal Institution and other scientific bodies, Prof. Bose was sent to the United States by the British government in order to acquaint American scientists with his work. He has lectured before our leading universities and scientific societies, with a success that is rare.

Prof. Bose has succeeded in demonstrating by actual experiment that there is no essential difference between an animal or plant in responding to external stimulus, that the mechanism of response is similar in both, and that there is no barrier whatever between the animal and the plant, such as we have imagined. Like an animal, a plant can be drugged, poisoned, exalted, depressed, and fatigued, and like an animal it proves to have nerves which transmit excitation with a measurable velocity.

**The Ingenious Instruments With Which Plants Write.**

This astonishing discovery was made with instruments of unprecedented delicacy, instruments which Dr. Bose invented for the very purpose of analyzing plant sensations. In Fig. 1 the principle of the instrument is set forth in a broad way. A graphic record of plant movements, however minute, must be made. Hence some form of writing lever must be used, which as shown, is connected by means of a very delicate thread with a leaflet. The writer is a thin vertical wire attached to a counterpoised horizontal lever, supported in frictionless jeweled bearings. As the leaf falls under excitation a glass plate is lowered at a uniform rate by clockwork, and upon the smoked surface of this plate the writer will trace a curve, which will be not only a record of the responsive movement, but a record of the time relations involved.

Such an apparatus might have been employed long ago had it not been for its obvious inaccuracy. It must be clear to every one that the friction of the writer upon the smoked glass completely vitiates the accuracy of the record. To make the system trustworthy

*(Concluded on page 256.)*

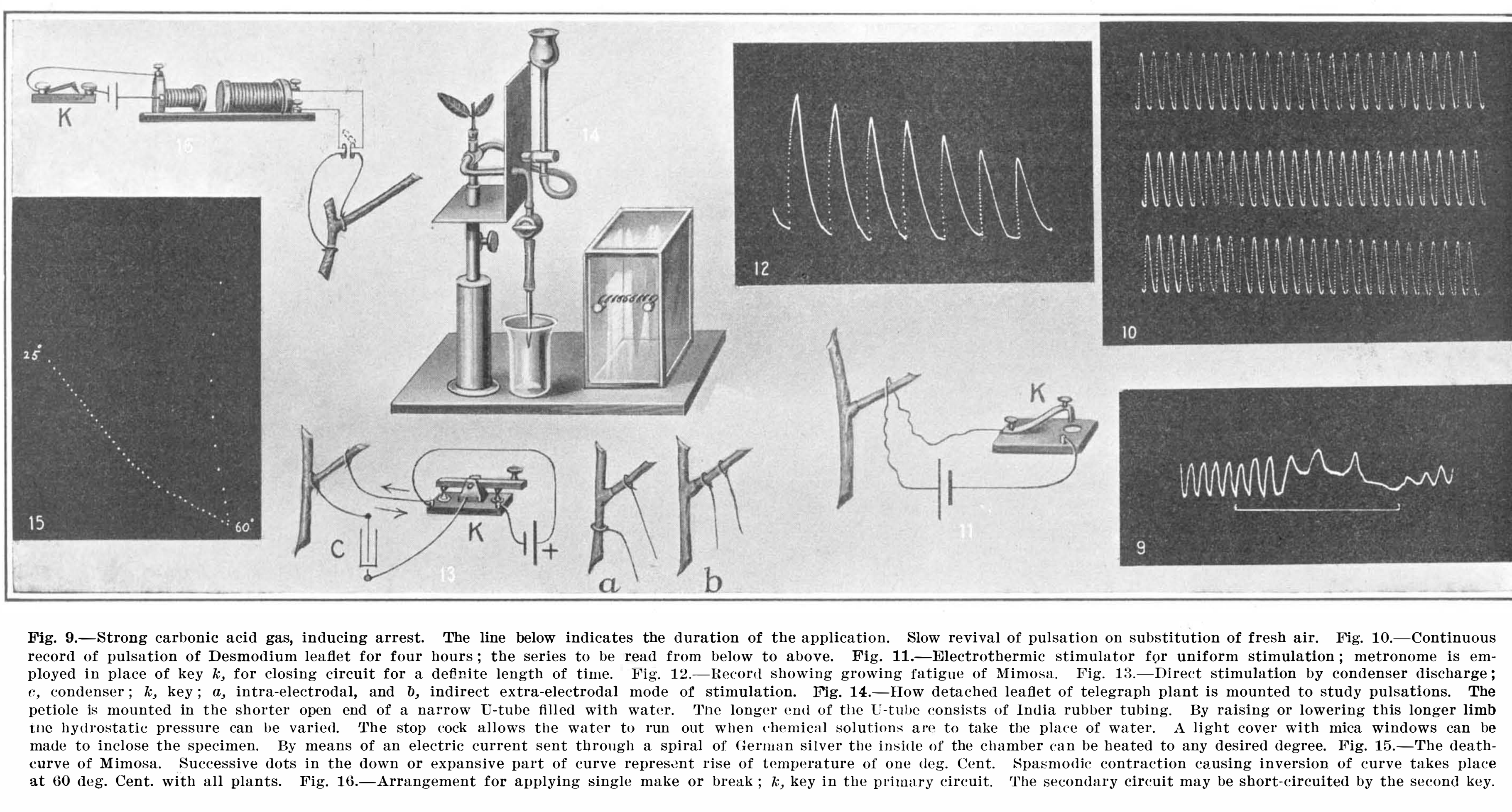


Fig. 9.—Strong carbonic acid gas, inducing arrest. The line below indicates the duration of the application. Slow revival of pulsation on substitution of fresh air. Fig. 10.—Continuous record of pulsation of Desmodium leaflet for four hours; the series to be read from below to above. Fig. 11.—Electrothermic stimulator for uniform stimulation; metronome is employed in place of key *k*, for closing circuit for a definite length of time. Fig. 12.—Record showing growing fatigue of Mimosa. Fig. 13.—Direct stimulation by condenser discharge; *c*, condenser; *k*, key; *a*, intra-electrodal, and *b*, indirect extra-electrodal mode of stimulation. Fig. 14.—How detached leaflet of telegraph plant is mounted to study pulsations. The petiole is mounted in the shorter open end of a narrow U-tube filled with water. The longer end of the U-tube consists of India rubber tubing. By raising or lowering this longer limb the hydrostatic pressure can be varied. The stop cock allows the water to run out when chemical solutions are to take the place of water. A light cover with mica windows can be made to inclose the specimen. By means of an electric current sent through a spiral of German silver the inside of the chamber can be heated to any desired degree. Fig. 15.—The death-curve of Mimosa. Successive dots in the down or expansive part of curve represent rise of temperature of one deg. Cent. Spasmodic contraction causing inversion of curve takes place at 60 deg. Cent. with all plants. Fig. 16.—Arrangement for applying single make or break; *k*, key in the primary circuit. The secondary circuit may be short-circuited by the second key.

## Hearing Liberty Bell Across the Continent

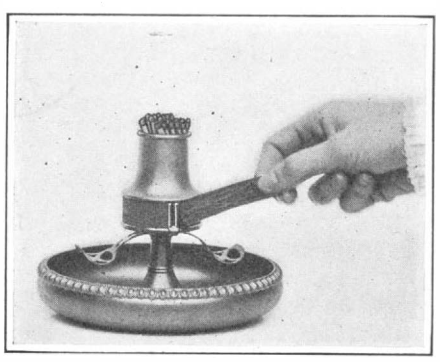
HISTORIC old Liberty Bell, which tried so valiantly to proclaim, far and wide, the joyful news of our declaration of independence, recently tried its voice again, and this time succeeded in making itself heard a thousand times farther. Fitted under the bell was a telephone transmitter connected with the transcontinental telephone line, and when it was tapped with the mallet the ring of the cracked old bell was heard in San Francisco. A record of this historic event was made by a phonograph so that the tones of the veteran of Revolutionary times might ring down through the ages.

## Iron Sides for Roads

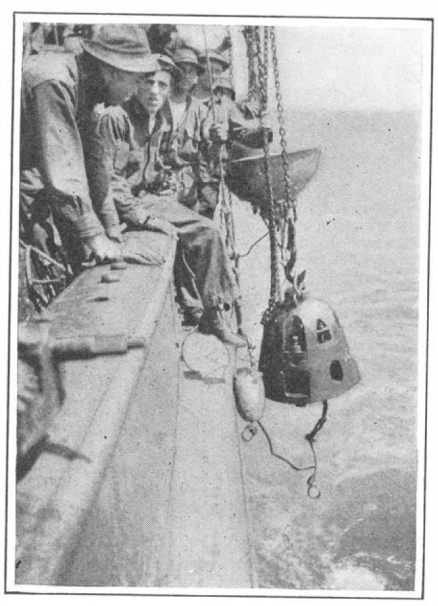
EVER since the Williamsburg bridge was constructed a great deal of trouble has periodically arisen over the shortness of the life of the pavements used in the road bed. No matter what sort of paving blocks were put down, the heavy nature of the traffic and the incessancy with which it flows soon resulted in deep, troublesome ruts along either side of the road. Lately this depreciation has gone forward at a considerably faster rate owing to the increased weight of trucks which pass over it.

After experimenting with every known type of pavement, the bridge engineers, as a last resort, hit upon the idea of lining the edges of the road, where the ruts occurred, with iron blocks. The blocks are cast hollow with open ends and sides, perforated tops and closed bottoms. They are afterward filled with concrete.

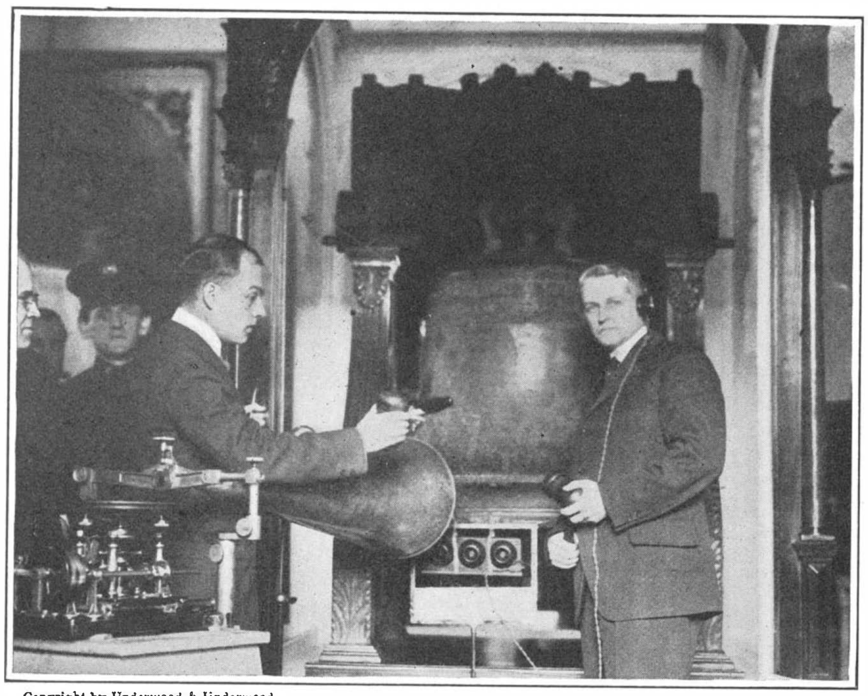
To break up the old pavements a pneumatic "rivet buster" was used, that is, a pneumatic hammer with chisel point employed in breaking and knocking out the rivets of worn out structural work. An engineer of the bridge paving department extricated a seemingly worthless machine of this type from the junk heap, had it repaired and put it to work on the old and rutted paving. The paving blocks were so firmly cemented that a man with a pick could scarcely make an impression on them. Under the blows of the rejuvenated "rivet buster," however, the paving blocks are readily broken apart.



**Safety match holder with a roll of striking tape.**



**Planting an electrically controlled mine.**



Copyright by Underwood & Underwood.

**Liberty Bell speaking across the continent.**

**Breaking up old pavement with a pneumatic "rivet buster.". The insert shows iron blocks for lining the road.**

## Safety Match Holder and Box

THE pocket match box has suffered a serious decline in recent years, mainly because safety matches have displaced the common friction matches in cigar stores, and they cannot be ignited on the ordinary striking surface. And so in place of the neat little case of gold or silver men have come to carry unsightly wooden match boxes or packets of paper matches. For a similar reason the match holder has given place to a stand in which a common safety match box is placed. Recently Mr. J. E. Neahr of New York city has devised a holder in which there is a roll of paper surfaced with the chemical coating on which the safety matches may be ignited. This striking tape runs around the base of the match container. Whenever the surface becomes worn a catch may be lifted and a new surface pulled from the roll. This will last for many months. A pocket safety match box has also been designed, at one end of which is a roll of striking tape. Normally this is covered to protect it from wear and dirt in the pocket.

## Mine-planting

THE accompanying photograph was taken aboard one of our own mine planters, and shows a type of mine with its automatic anchor. The anchor weighs 1,500 pounds, and the mine is loaded with a hundred pounds of trotol. The mine is of the controlled type, which can be fired only by an electric current supplied from a station on shore. The photograph shows it hanging over the side of the mine planter, ready to be dropped into the water by tripping the hooks which support it, when the vessel reaches the desired location.

## The Nipa Palm of the Philippines

AMONG the physical assets of the Philippine Islands is the Nipa palm, the sap of which has the important distinction of being the cheapest raw material known in the world for the making of sugar and alcohol. After extraction from the flower stalk this sap is known as "tuba" and contains, when fresh, about 15 per cent of sugar. Investigations made by the Philippine Bureau of Science bear the definite conclusions that nipa sugar is equal to cane sugar and can be extracted cheaper, as no crushing machinery is necessary; also, that a hectare (2.47 acres) of nipa will produce 22,942 pounds of sugar, which, valued in United States currency at 8 cents per kilo (2.2 pounds) would yield an annual income of more than $800.

The yield of alcohol varies, depending on the grade of the primary product. It has been found that a hectare of nipa (about 2,000 plants) will average 21,500 gallons of sap per year; and that from four to 7.5 gallons of sap are required to produce 0.25 gallon of alcohol. Nipa alcohol was awarded the first prize for purity at the Paris Exposition.

The use of alcohol of 186 proof, mixed with 10 per cent gasoline, has been shown to be of equal effectiveness with pure gasoline in a year's continuous trial in six automobiles in Manila. That city imports about $200,000 worth of gasoline each year, which apparently could be supplanted by alcohol. Up to the present time no forest charges have been assessed on nipa products by the Government of the Philippine Islands, although such assessment is levied by the local governments of neighboring European colonies in the East Indies.

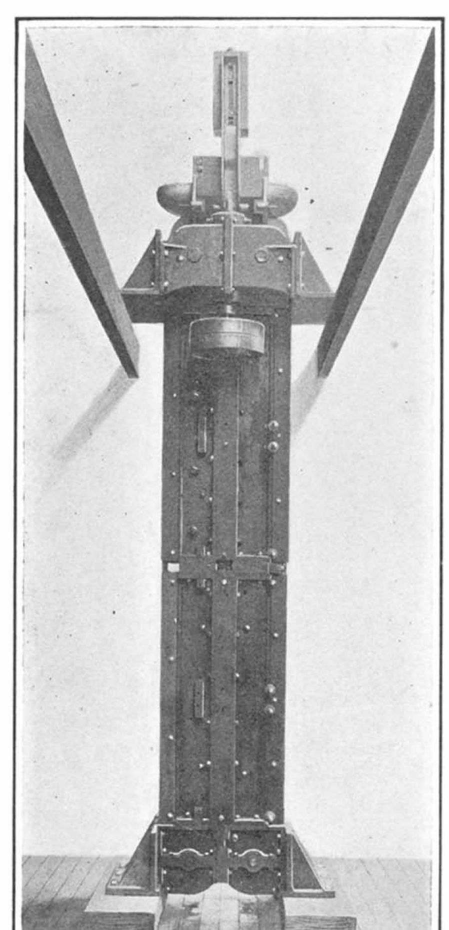
## Award by the Franklin Institute

MR. GEORGE P. VANIER, chief chemist of the Pennsylvania Steel Company of Steelton, Pa., has been awarded a certificate of merit by the Franklin Institute, Philadelphia, Pa., for his potash bulb. This bulb has been particularly designed for use in the determination of the total carbon in iron or steel. The bulb is of large capacity, and, by the provision of a glass spiral in which the gases of combustion of the sample under test and the potash solution circulate together, a high rate of absorption of carbonic acid is obtained. With the bulb is combined a drying tube. Mr. Vanier has also designed zinc tubes and sulphuric acid bulbs for use in connection with the Vanier combustion train for the determination of carbon in steel by direct combustion method with the electric furnace. Both of these pieces of apparatus are great time savers in commercial laboratories.

## Continuous Rod Machine

PICTURED herewith is a machine for making continuous rods of brass and the like. Molten metal is poured in at the top and brass or other rods of 7/8 inch or more in diameter will run out at the bottom as long as the metal supply keeps up and electric current is furnished for the operation of the mechanism. At the top of the machine is a graphite crucible into which the metal is poured, and through which it finds its way by gravity into a guiding tube and eventually into the molding bore of the machine. By the junction of two sections of molding blocks which form two endless chains, respectively, a two-part mold is effected. With the metal being fed into the receiver at the top and the chain molds being continuously moved, the liquid metal molds, solidifies and delivers itself automatically in the shape of an endless rod.

The operation is strictly mechanical and automatic, and it is the claim of the inventor, a man from Newark, N. J., that with the aid of the machine 7/8 inch rod in any length should cost less to produce than wire bar. The rod from the machine can be produced without any previous working and all rolling operations are done away with. The machine is driven by a 6 horse-power motor.



**Machine for casting continuous lengths of rod.**

## The Paris Observatory and Its Work

(*Concluded from page 251.*)

circle, and it is used to point the telescope to the approximate position of the object to be observed.

The divisions of degrees and minutes on the outer circle are read by six microscopes, which give the seconds and tenths to complete the distance the object is from the zenith. The microscopes are mounted on the exterior face of the east pier and are secured on lugs attached to cast iron standards bolted to the pier.

When the instrument was first mounted the field of the eye-piece was illuminated by means of a gas jet, opposite the axis of rotation, and on top of the west pier. The axis of the instrument is perforated, and a movable diaphragm therein regulates the intensity of the light.

With this instrument the Paris Observatory carried on its extensive series of observations for the determination of the position of the sun, moon, planets, and stars. When the instrument was first mounted its object glass was the largest that had ever been made for a transit circle, and it is to-day the largest in use. However, astronomers have found that when the most refined work is desired, with that class of instruments, one of less aperture and less focal length will yield better results. The astronomers of the Paris Observatory recognized that, and in 1878, through the liberality of M. Bischoffsheim, a new transit circle was provided, and upon much smaller dimensions.

The new instrument is mounted in an isolated building in the grounds of the Observatory, about 150 feet south and a little east of the large transit circle. Its object glass has an aperture of 7.5 inches and a focal length of 7 feet 7 inches. With this new meridian circle the Paris Observatory has continued its meridian circle work, the larger one being now used merely for the purpose of obtaining accurate time. This is distributed from the Observatory over the railroad telegraph lines in France, and also by wireless from the powerful station at the Eiffel Tower, for the benefit of the shipping at the sea ports of France and also ships at sea.

One of the unsolved problems in astronomy is the probability of changes taking place in the crater formations and mountains on the moon. In the early history of the science certain astronomers, from visual observations secured by means of a telescope, made drawings of all the prominent objects on the surface of the moon, but at best that process could not compete with a well-developed photograph of the lunar surface. In making a drawing the operator can sketch only so fast, and while he is engaged upon the drawing the reflected sunlight and the shadows caused by its absence are constantly changing on the object he is attempting to transfer to paper. With a relatively quick photographic plate a much more detailed reproduction of any selected region on the moon can be secured in a very short interval.

An instrument designed with that purpose has been in operation for a number of years at the Paris Observatory. It is called an equatorial *coudé*, and it was first planned by M. Loewy, another of the illustrious directors of that institution. The mechanical form of the instrument is not at all similar to that of the ordinary equatorial refracting telescope. Imagine the main tube fastened to two upright piers, the one to the north much higher than the one to the south. This main tube is constructed so that it will revolve on a bearing at the top of the shorter pier. It is fastened to the longer pier by a sleeve, so the main tube can revolve. The angle of elevation of the tube is the same as that of the latitude of the place.

Near the lower end of the main tube is another, clamped to it so as to form a right angle at the point of joining. On the opposite side is another tube, attached to the main tube, and its purpose is to act as a counterpoise for the whole instrument. At the extreme end, and at the side of the second tube mentioned, is placed the object glass. A 45-degree mirror is fastened in the end of the tube, and another in the cube formed by the junction of the two tubes. A ray of light from a celestial object enters through the object glass, strikes the mirror at that point, is deflected down the tube until it reaches the mirror in the central tube, when it is again deflected up the main tube to either the eye-piece or the photographic plate.

In this form of instrument the astronomer remains seated at the eye end all the time he is observing or photographing, as the diurnal motion given the instrument by clockwork, to follow a celestial object, is around the eye end as an axis. The eye end of this instrument is shown in one of the illustrations.

The equatorial *coudé* has the following dimensions: The length of the tube containing the object glass is 5 meters. The length of the tube opposite to that of the one containing the object glass is 4 meters. The length of the tube to which the eye-piece or plate holder is fastened is 12 meters. The diameters of the tubes vary from 0.6 to 1 meter. The aperture of the object glass is 0.6 of a meter, and its focal length is 18 meters. The diameter of the exterior mirror is 0.86 meter, and of the interior one 0.73 meter.

In designing this instrument it was the intention of the illustrious astronomer to have made a telescope that would exactly reproduce, without enlargement, images of heavenly bodies. The construction of the telescope was commenced in 1889, and it was finished in April, 1890. The first observation was made with it in 1891.

With this equatorial *coudé* MM. Loewy and Puiseux have secured the splendid atlas of the moon that has been issued by the Paris Observatory, and in the vaults of that institution are more than two thousand photographs of the lunar surface. After these photographs were obtained MM. Loewy and Puiseux made a careful study of the hundreds of lunar formations thus obtained, and their writings upon that subject fill many pages of the publications of the French Academy of Sciences. The crowning work of all was the Atlas of the Moon mentioned. In this will be found enlarged reproductions of all the mountains, craters, dead seas, and plains that can be seen on the moon. The lunar enlargement varies from a diameter of 2 to 2.5 meters. The original negatives were 0.18 of a meter in diameter. The atlas is without doubt the finest reproduction of the visible portion of the lunar surface that exists, and the student of lunar formations will find in these enlargements a study of the highest interest.

In the future, astronomers who obtain photographs of the moon have the means, by placing their photographs alongside those secured with the equatorial *coudé* of the Paris Observatory, to carefully compare every portion of the lunar surface, and to detect any change that has taken place in any crater or mountain formation in the interval between the time the first and second photographs were taken.

As the actual position of the moon in the sky at any instant holds but a short while to any theory of its motion that has yet been developed, and its predicted position for the future is liable to uncertainty, so it is impossible to state definitely that any of its craters or mountains have changed or are changing until photographs of sufficient size are compared one with the other. It is from such a collection we may expect to verify supposed changes, by comparison, over long intervals of time.

## The Heavens in March

(*Concluded from page 252.*)

of February 10th. It was then in Ophiuchus, in 17 hours right ascension and 3 degrees north declination, and was moving slowly southward. Preliminary elements compiled at the University of California indicate that the comet is still remote from the Earth and Sun and will not come to perihelion till next August; but the comet's situation is such that the computed elements are uncertain, and more observations will be necessary to permit of accurate prediction. For the present, however, the comet will continue to travel slowly southeastward, and grow brighter. Its predicted position on March

1st is right ascension 17 hours 26 minutes 37 seconds, declination 1 degree 43 minutes north, and its motion 1 minute 15 seconds east and 5 minutes south every day. It should be easily visible in the morning sky for some time to come.

Princeton University Observatory.

## Plant Autographs and What They Mean

(*Concluded from page 253.*)

Dr. Bose hit upon the ingenious principle of electro-magnetically tapping the smoked glass plate at regular time intervals, so that a dotted line is obtained instead of a continuous curve. Thus he was able to overcome at once the difficulty of friction.

But the invention of an instrument which would tap instead of trace records was not the easy task that might be supposed. Limitations of space forbid our discussing with the fulness they deserve the problems that confronted Dr. Bose. Eventually he devised the instrument—his "resonant recorder"—shown in Fig. 2. This instrument is so constructed that the recording point is given an electrical impulse exactly perpendicular to its recording movement; the intermittent closures of the electric circuit are properly timed, so that the writing index is not subjected to attraction in the course of its journey; the electro-magnet employed is cylindrical and therefore without laterality, so that the writing index cannot have a tendency to execute its to-and-fro vibrations in any other direction than that which is perpendicular to the plane of the terminal pole of the magnet. The electrical impulses are timed with the greatest regularity by means of a reed maintained in a state of persistent vibration by the usual electro-magnetic arrangement. This reed interrupter, called a coercer by Dr. Bose, is tuned to the natural frequency of vibration of the recording index, so that the intermittent magnetic pulls will exactly synchronize with the natural swings of the writing index.

The advantage of intermittent over continuous contact in obtaining records is well shown in Fig. 3, representing two successive experiments on the same leaf under identical stimulation. The lower record was taken with continuous contact and the upper with the same recorder, but in a state of vibration, giving intermittent contact. Stimulus was applied at the point marked by the vertical line.

### How Plants are Stimulated.

Dr. Bose classifies stimuli into (1) mechanical (blows or pricks), (2) chemical (acids, alkalies, etc.), (3) thermal (hot wires, etc.), and (4) electrical (inductive shock, condenser discharge, constant current, etc.). Since chemical stimuli cannot be employed to obtain a series of uniform excitations for quantitative investigation, and since blows and pricks may cause mechanical jars which may affect the record, Dr. Bose prefers the thermal and electrical modes of stimulation, and, accordingly, employs the electro-thermic stimulator shown in Fig. 11, the condenser discharge apparatus shown in Fig. 13, and the induction shock apparatus shown in Fig. 16.

When a muscle is excited there is a brief interval between the incidence of the stimulus and the beginning of the responsive movement—a lag which is called the "latent period." After the lapse of the latent period the record-curves increase in amplitude to a maximum. The period required up to this point Dr. Bose calls the "apex time." With the resonant recorder Dr. Bose has found that different plants exhibit different characteristics of response. In summer Mimosa has a latent period of one tenth of a second; the maximum fall of the leaf was attained in three seconds (apex time), and the recovery was completed in fifteen minutes. The movement of recovery is about three hundred times slower than the excitatory fall, in this instance. Increase the stimulus and the extent of response increases. The stronger the stimulus and the higher the temperature the greater is the increase in the rate of movement. Fatigue decreases the rate. Winter produces a physiological depression which prolongs the latent period and reduces the amplitude.

### All Plants are Sensitive.

Thus tested, all plants prove to be responsive. Hence, the old distinction between "sensitive" and "insensitive" plants is purely arbitrary and scientifically unjustified. Cabbages, peas, beans, and other kitchen vegetables are sensitive, although not so highly excitable as Mimosa. By means of electrical response, moreover, Dr. Bose has shown that every plant and every organ of a plant is sensitive and responds to stimulation by a definite electrical charge. An intensity of induction shock which is barely sufficient to induce sensation in man is quite enough to cause excitatory fall in a Mimosa of moderate sensitiveness. Indeed, Dr. Bose found that a highly excitable specimen can, under certain conditions, be ten times as sensitive as a man!

If, instead of permitting a plant to recover sufficiently after shock, it be stimulated again, a diminution in the height of response, indicative of fatigue, is noted. In a highly excitable specimen the phenomenon of growing fatigue can be easily recorded; in a sub-tonic specimen, an equally characteristic effect is obtained—a gradual enhancement or what is known in muscle investigation (with which it is exactly parallel) as a "staircase response" (Fig. 7). After attaining a maximum excitability under successive stimulation, there generally ensues a fatigue decline. This is to be attributed to the gradual bettering of the tonic condition under successive stimulations. In other words, the accession of stimulus gives rise to two kinds of effects—external and internal.

So sensitive are plants that even the passing of a cloud is not without influence, as Prof. Bose's records conclusively prove. Carry a highly excitable plant into a dark room and its excitability disappears for an hour. Prof. Bose noticed that Mimosa was depressed on rainy days. He was able to trace the cause to the absorption of water. Fig. 6 is a record which is instructive in this respect. A pair of uniform responses were first taken. A drop of water was then applied at the proper place (the pulvinus), when the leaf was recovering from the second stimulus. It will be noticed that the period of recovery became very much protracted in consequence of absorption of water. The plant was gorged, and like a gorged animal, its sensitivity had been affected. A drop of glycerin abstracted the water and restored excitability.

### How Plants Suffocate and are Poisoned.

Gases have as marked an effect on plants as on animals. Carbon dioxide is popularly supposed to be good for plants. Prof. Bose shows that it is just as depressing and poisonous to a plant as to an animal. Ozone, as might be expected after this, is stimulating, so much so that a fatigued plant can be refreshed by its means. Alcohol vapor produces first exaltation and then depression, the plant responding in a very human way. Ether likewise depresses, but is not so narcotic as chloroform. Carbon disulphide resembles ether in its effect. Coal gas is moderately depressing. Ammonia abolishes excitability, for as long as two hours, if strong vapor is employed. Sulphureted hydrogen is not only depressing but extremely poisonous in its effect, and since it is found in large quantities in city atmospheres we can now well understand why it is impossible for some plants to thrive in towns at all. Nitrogen dioxide is fatal, and so is sulphur dioxide.

That plants die like animals we all know; but we do not know the exact moment when they die. For hours a dead plant seems alive. There is no twitch, no death spasm. Dr. Bose has succeeded not only in noting the precise moment when a plant gives up its life, but in recording its death spasm. The plant is heated very gradually so as to avoid all excitation. This is done by placing the plant in a water bath, the temperature of which is continuously raised by the application of a gas or spirit flame. At 60 deg. Cent. a spasmodic extraction takes place, clearly indicated in the record produced in Fig 15, which is in truth a death curve. All attempts to obtain response, after this



INQUIRIES

*Inquiry No. 9416.* Wanted an agency on the Pacific Coast for some specialties. Particularly inventions of merit.

*Inquiry No. 9417.* Wanted the name and address of a manufacturer of a machine for tying up fishing line and for carding the same

*Inquiry No. 9418.* Wanted the name and address of a manufacturer of fiber silk made of wood, a fiber suitable for undervests, etc.

sharp inversion of the record, fail, even though the plant is cooled down to its normal temperature. This death temperature of 60 degrees is constant for all plants.

**Nerves or Mechanism—Which?**

Is there a true excitatory change in the plant? If so, is there any specific contracting tissue, corresponding with the nerve of the animal, for the transmission of excitation? It is known that the excitation of a living animal tissue is attended by a concomitant electrical change of galvanometric negativity. If we make suitable galvanometric connections with two points on a nerve and we stimulate the nerve at a distant point, we shall find that the arrival of excitation from the distant stimulated point is at a proper moment signalized in the galvanometer by a deflection of a definite sign. Prof. Bose has found that the excitatory change of galvanometric negativity is similarly transmitted to a distance through certain plant-organs, thus proving that plants have nerves. By applying stimuli of constant intensity and by allowing proper intervals of rest, Prof. Bose has obtained successive values of the velocity of transmission, which values are constant. The highest velocity of transmission of excitation was found to be 30 millimeters a second in the petiole of Mimosa. The velocity varies with the tonic condition of the plant. Fatigue depresses the rate; high temperature increases it. Excitation is transmitted in both directions; but the velocity is not necessarily the same in the two cases.

Until Dr. Bose made his experiments it was the accepted theory that in plants like Mimosa there is merely a transmission of hydro-mechanical disturbance and no transmission of true excitation comparable with that of animal nerve. Haberlandt compared the excitatory movement of a Mimosa leaf with the effect produced when an India rubber tube containing water at a given hydrostatic pressure is pinched, with the result that the increase of pressure at any point is transmitted in the form of an undulatory wave. If this is so, transmission should always take place regardless of the physiological conditions. Haberlandt's theory and others like it must be abandoned. Prof. Bose found that excitatory reaction is indicated in the petiole of various plants by the discriminative polar action of an electric current; excitation is induced at the kathodic point at "make" and at the anodic point at "break." This transmission occurs in the absence of all mechanical disturbances. The excitatory nature of the impulse is further demonstrated by the arrest of conduction brought about by various physiological blocks. Moreover, local application of increasing cold retards and finally abolishes conductive power. Conductivity is even paralyzed for a time as an after-effect of cold, but the conducting power is quickly restored by tetanizing electric shocks. Conductivity of a selected portion of the petiole may be abolished by local application of poison, such as potassium cyanide. It is quite evident from all this that a plant, like an animal, has nerves.

**Plant Tissues That Beat Like Hearts.**

In certain plants we observe what are known as spontaneous movements. *Desmodium gyrans* or the telegraph plant of India is a conspicuous example. The lateral leaflets execute pulsating movements which are not unlike the rhythmic movement of the heart. Prof. Bose has studied this curious phenomenon and finds that it has more than a superficial resemblance to the beating of cardiac tissue.

Because a whole plant cannot be easily manipulated, Prof. Bose experiments with the detached petiole. A similar practice is followed by biologists in studying the action of the animal heart. As in the case of the isolated heart, the movement of the detached leaflet can be renewed by the application of internal hydrostatic pressure. The detached petiole is mounted in the apparatus shown in Fig. 14. In some experiments a modification of the resonant recorder must be employed—an instrument which Prof. Bose calls his oscillating recorder, in which the recording plate, by means of an electric motor provided with an eccentric is made to execute a to-and-fro movement. Thus, it becomes possible to use a light grass haulm for the recorder. When the resonant recorder is used the record appears dotted; with the oscillating recorder a dotted record is obtained. Fig. 10 shows how very regular are the pulsations obtained with detached petioles; this is a continuous record lasting four hours, the movements themselves being maintained uniform for more than seven hours.

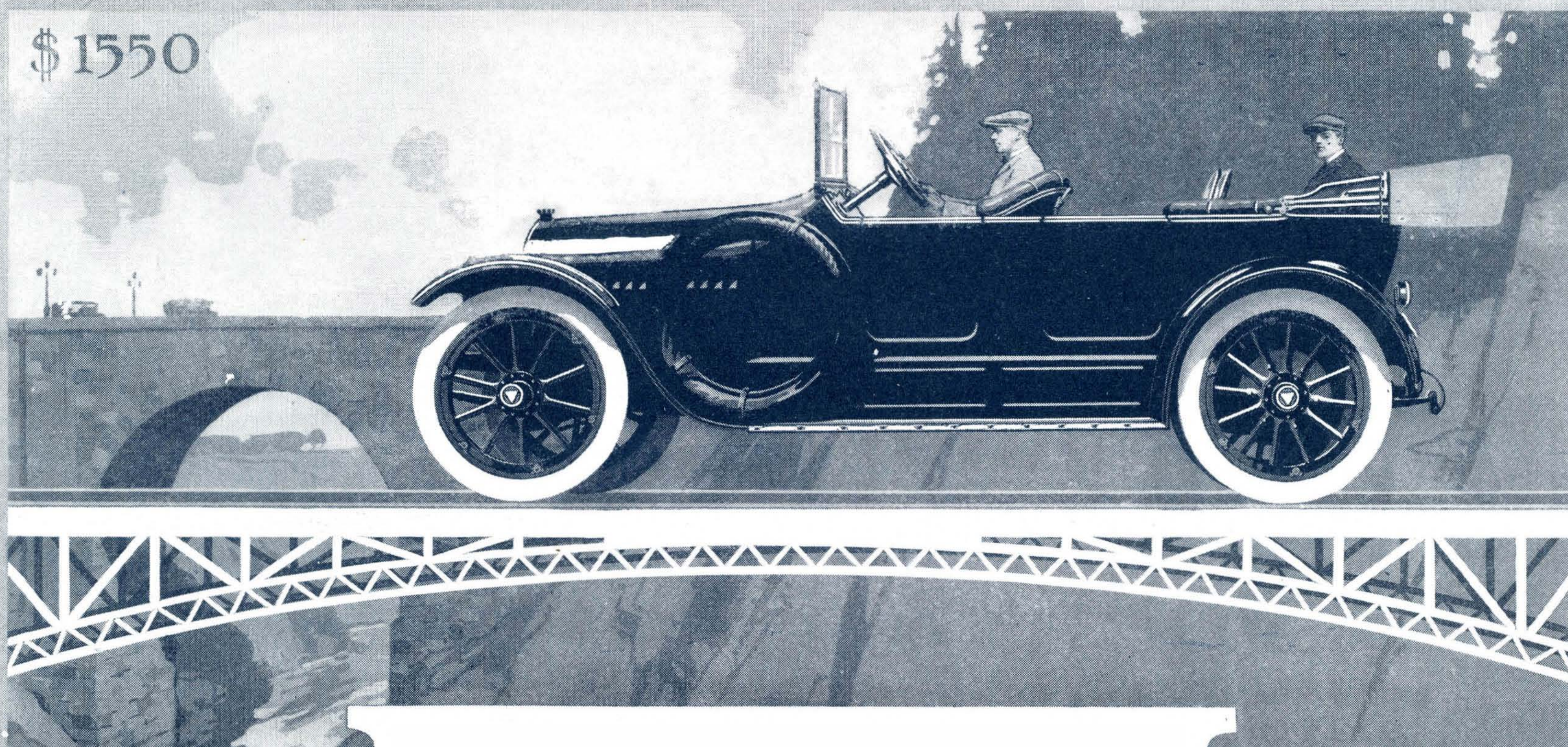
The records obtained show that the rhythmic tissues of the plant are extraordinarily similar to those of the animal. By the application of ligature the pulsation of the heart is arrested; a similar arrest occurs in the telegraph plant by the proper application of ligature. Cold lowers the frequency of a frog's heart beat; it also lowers the frequency of the telegraph plant's pulsation. Rise of temperature produces an opposite effect in both the animal heart and in the beating leaflet. Alcohol and dilute carbon dioxide prolong the period, while strong applications arrest pulsation altogether. Dilute vapor of ether and carbon disulphide induce a temporary arrest, revival taking place after substitution of fresh air. Copper sulphate and potassium cyanide, both poisons, stop pulsation, potassium cyanide the more quickly of the two.

No satisfactory theory has been offered to explain these "spontaneous" movements. Prof. Bose believes that he has shown that there is no such thing as a spontaneous movement. The energy that makes a heart beat or a leaflet vibrate is derived from external sources directly or from the excess of such energy already accumulated and held latent in the tissue. When the stored supply is exhausted activity ceases, only to be renewed again by fresh stimulation.

With his remarkable instruments Prof. Bose has thus subjected plants to questioning shocks and recorded their answers. His records are in reality autographs which lay bare processes which have been wrapped in the profoundest mystery. The effects of environment, of stimulation, of variations in physiological activity are written down in a script that is as intelligible as the printed word on this page. The plant proves to be more closely allied to the animal than we suspected. Indeed, there is hardly any phenomenon of irritability observed in the animal which is not also found in the plant. Prof. Bose has therefore made not only a notable contribution to plant physiology, but he has widened our whole conception of organic life and has proved that there is but one life, whether it be the protoplasmic scum of a murky pool or man himself.

## The Death of Lieut. Munby

We regret to note that Lieut. Ernest John Munby of the British Royal Engineers has been killed in action. Mr. Munby was born at Turvey Beds, Bedfordshire, England, May 19th, 1875. He attended the famous Rugby public school, and in 1893 came to the United States and entered the Stevens Preparatory School at Hoboken, and later attended the Stevens Institute of Technology, from which he graduated in 1897 with honors. Mr. Munby was a mining engineer and practised his profession in various parts of the country. He was also an engineer on the Steinway tunnel. In 1907 he became an associate editor of the Scientific American and continued in this capacity until his professional labors called him to Colorado. Mr. Munby went to England last summer, intending to return to Colorado in the autumn. At the outbreak of the war Mr. Munby was extremely anxious to volunteer. There were some difficulties at first, as at that time they were accepting only comparatively young men; finally, however, his professional attainments won the day, and he was commissioned as a lieutenant in the Royal Engineers. Since the outbreak of hostilities we received several interesting letters from Mr. Munby, which showed his rare ability as a correspondent. All Mr. Munby's friends will be sorry to learn of his heroic death.




## Lightness Can Be Combined With Strength

# HUDSON PROVED IT

When light steel bridges took the place of stone, there came up the question of strength in them.

When steel buildings displaced solid masonry, the question arose again.

So in automobiles. The early high-grade Sixes weighed 4500 pounds. That overtax in tires and fuel barred the Six to most men. Now it is known that overweight was a crudeness, a weakness in itself.

### The Hudson Remedy

Howard E. Coffin, the great HUDSON engineer, long ago decided that lightness could be combined with strength. He displaced cast iron with aluminum. He adopted pressed steel. He re-designed a thousand parts to secure staunchness without weight. His hollow driving shaft illustrates one method of weight reduction.

Then he designed a small-bore, high-speed motor. That let him lighten a hundred parts because of the lesser shocks.

After four years of effort, the final result is this HUDSON for $1550. It weighs 2890 pounds, ready for the road. As compared with old-time Sixes, it has cut fuel and tire cost in two.

### Excess Out-of-Date

The Light Six vogue started with this HUDSON. Now crude excess is distinctly out-of-date. The leading cars average hundreds of pounds less than last year. But the HUDSON, because of our years of refinements, is the lightest in its class—the lightest 7-passenger Six.

This year, if you pay between $1000 and $2000, you are pretty sure to want a Light Six. Your sole question is, "Which is the best Light Six"?

### 10,000 Men Say Hudson

Over 10,000 men chose the HUDSON. Half of them bought last year's model, and have driven it two seasons. Half bought this year's model. Together they have driven this car, perhaps 25 million miles.

They have proved it right. They have found no weakness, no shortcoming. Any owner around you will say that.

That's the all-important point. Every old-time standard has been radically revised in creating the Light Six. And only time and tests can demonstrate the avoidance of mistakes.

The HUDSON has met those tests. It is a proved success. Its buyers take no chances. It is, in addition, a Howard E. Coffin model. It is a finished product, showing the results of four years of refinement. We believe that you'll select it.

HUDSON Six-40 Seven-Passenger Phaeton, $1550, f. o. b. Detroit. Four other styles of bodies.

The HUDSON Company never loses interest in the cars it sells. So long as a car is in service we maintain our interest in the character of its service. That's one great reason for HUDSON reputation.

**HUDSON MOTOR CAR COMPANY**
**Detroit, Michigan**

# SCIENTIFIC AMERICAN

Vol. CXII. No. 12
March 20, 1915

Munn & Co., Inc., Publishers
New York, N. Y.

Price 10 Cents
$3.00 A Year

SEVENTY-FIRST YEAR

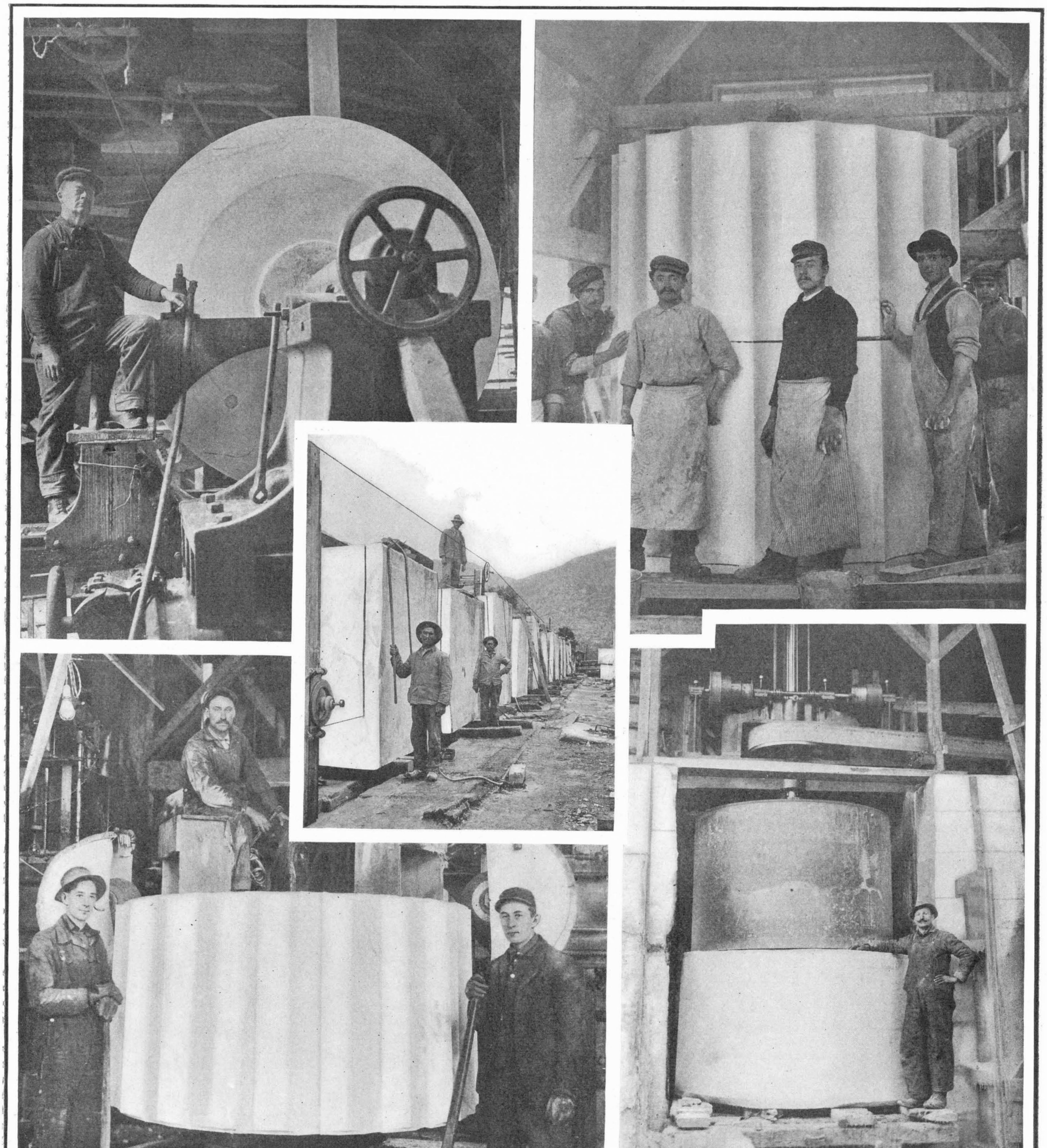
# SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

VOLUME CXII.
NUMBER 12.

NEW YORK, MARCH 20, 1915

10 CENTS A COPY
$3.00 A YEAR



The middle picture shows 300 tons of marble being sized up with wire saws. In the lower right-hand view is a block which has been cut into a drum with the barrel saw shown above and slightly to the rear. At the upper left the drum is being turned on a lathe. At the lower left the drum is being fluted. At the upper right the drums are being finished. There are twelve of these drums to a column.

**AT WORK ON THE HUGE MARBLE COLUMNS OF THE LINCOLN MEMORIAL.**—[See page 267.]

# SCIENTIFIC AMERICAN

**Founded 1845**

**NEW YORK, SATURDAY, MARCH 20, 1915**

Published by Munn & Co., Incorporated. Charles Allen Munn, President; Frederick Converse Beach, Secretary
Orson D. Munn, Treasurer
all at 361 Broadway, New York

Entered at the Post Office of New York, N. Y., as Second Class Matter
Entered as Second Class Matter at the Post Office Department, Canada.

Trade Mark Registered in the United States Patent Office




**Subscription Rates**

| | |
|---|---|
| Subscription one year ................................ | $3.00 |
| Postage prepaid in United States and possessions. Mexico, Cuba, and Panama | |
| Subscriptions for Foreign Countries, one year, postage prepaid, | 4.50 |
| Subscriptions for Canada, one year, postage prepaid......... | 3.75 |

**The Scientific American Publications**

| | |
|---|---|
| Scientific American (established 1845)..........per year. | $3.00 |
| Scientific American Supplement established 1876. " " | 5.00 |
| American Homes and Gardens................ " " | 3.00 |

The combined subscription rates and rates to foreign countries including Canada, will be furnished upon application.
Remit by postal or express money order, bank draft or check

**Munn & Co., Inc., 361 Broadway, New York**

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp* the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.


*The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.*

## The Lesson of the "Queen Elizabeth"

THE successful forcing of the Dardanelles by the Allied fleet is giving much food for thought to the ordnance officers who are responsible for our coast fortifications. When these great defensive works were planned by the Endicott Board some twenty years ago, and later revised by a board under the Taft Administration, the present realization of the controlling power of large caliber and great range had not been reached. Theoretically, these things were well understood, but the consensus of opinion—perhaps to be more correct, we should say the controlling opinion—in the Board of Ordnance of the United States Army, was in favor of using nothing larger than a 12-inch gun with a muzzle velocity of from twenty-two to twenty-five hundred feet per second.

The Endicott Board, it is true, made provision for mounting a certain number of 16-inch guns; but only one of these—a type gun—was made and tested; and so satisfied was our Ordnance Board that a 12-inch rifle of moderate velocity would prove sufficient to reach and penetrate the armor of any enemy's battleship, that the 16-inch gun, after firing a few rounds, was permitted to lie on its temporary mount at the Sandy Hook proving ground for a great many years, where it was regarded as something of a white elephant. Only recently has this powerful gun been provided with a mount and shipped to Panama, there to take its place as the most powerful gun in the canal defenses. The 12-inch coast-defense gun fires a 1,000-pound shell, with a muzzle velocity of twenty-five hundred feet per second, and its extreme range, as governed by the maximum elevation which can be given to the piece on its disappearing mount, is about thirteen thousand yards.

Some ten years ago the Board of Ordnance determined to raise the caliber of our heavy coast-defense guns from 12 inches to 14 inches. Had the velocity been maintained at the twenty-five hundred feet per second mark attained by the 12-inch gun, our fortifications would have been armed with a piece of greater range and far greater striking energy at the distant ranges than the 12-inch gun; but, unfortunately, the Chief of Ordnance determined to sacrifice the power and range of the gun to its longevity, and in the endeavor to reduce erosion he lowered the velocity of the new 14-inch gun from twenty-five hundred to twenty-two hundred feet per second—thus, at a stroke, sacrificing both the range and the energy of what otherwise would have been a very fine and thoroughly up-to-date gun.

The ranging power of our coast defense guns is seriously curtailed by the limited maximum elevation of which they are capable. With the exception of twenty-nine, which are on barbette mounts, the whole of our one hundred and thirteen 12-inch guns are mounted on the Buffington-Crozier disappearing gun carriage; and for reasons which are not quite clear to us, although we have heard that it was in order to lessen the racking effects of the recoil, these mounts permit the guns to be given the very limited maximum elevation of 10 degrees—a fatal error, for which the whole of our coast fortifications are now paying a heavy penalty in finding themselves utterly outranged by the heavy guns of the latest foreign warships. As matters now stand, the maximum range of our 12-inch guns, with a 1,000-pound shell, is thirteen thousand yards. By a change in the carriage, increasing of the elevation to 15 degrees, and reducing the weight of the shell to 700 pounds, it would be possible to cover eighteen thousand yards, but this, of course, would involve lower penetrating power and a much smaller bursting charge in the shell.

At the time when Gen. Crozier introduced the 14-inch gun and made what seems now to have been the fatal error of reducing the velocity to twenty-two hundred feet per second, the SCIENTIFIC AMERICAN protested bitterly against a policy of sacrificing range and hitting power in order to lengthen the accuracy life of the gun. The General pointed out to the writer at that time that the lower velocity was compensated for by the greater weight of the shell, and that the hitting power of the new 14-inch was somewhat greater than that of the 12-inch high-velocity gun. We then thought, and we now think, that it was nothing less than a calamity, that when introducing the big 14-inch guns, the high velocity of the 12-inch gun was not adopted or even that the velocity was not raised to twenty-six hundred feet (which is the standard velocity for the Navy 14-inch guns); for in that case our coast fortifications, and especially the latest works of this kind, as at Panama, would be in a position, to-day, to match gun with gun and range with range against any foreign ships that are afloat on the high seas.

As a matter of fact, we learn that in the attack on the Dardanelles the latest British dreadnought, "Queen Elizabeth," reduced one of the strongest forts in the narrows of the Dardanelles from a distance of twenty-one thousand yards, or over eleven and a half miles. Had the "Queen Elizabeth" been attacking Fort Hancock at Sandy Hook, she could have taken position and steamed to and fro eight thousand yards outside the maximum range of the 1,000-pound shells of the 12-inch batteries, and proceeded to drop her 15-inch shells into the open emplacements of the rifles and even into the sunken pits of the mortar batteries.

But the "Queen Elizabeth" is not the only ship afloat that could reduce any of our coast fortifications without the slightest risk to herself; for practically all of the dreadnoughts of foreign powers could do the same thing. If the reader doubt it, we invite his attention to an article on the North Sea fight, in which we give a diagram showing the maximum range of the armor-piercing guns carried in the German fleet; and from this we learn the disconcerting and truly amazing fact that because of the high velocity and wide range of elevation of the German guns, it would have been possible, had hostilities occurred with that country, for the German armored cruisers such as the "Scharnhorst," "Gneisenau," and "Bluecher," to have covered any of our coast fortifications with a rain of high explosive shells from a distance of twenty-two thousand yards, or over twelve miles. Had they used their dreadnoughts they could have done the same thing from a distance of twenty-six thousand yards, or six or seven miles beyond the maximum distance to which the guns of our coast fortifications could throw their 1,000-pound projectiles. While bombarding the forts, the ships would be hull down at these ranges; but the aeroplanes, and observation by other ships, would make it perfectly possible in reasonably clear weather accurately to direct the bombardment.

As we said at the outset: There is food for thought in all this.

## Light Reading for Polar Explorers

AN English journal describes the library carried by Shackleton's expedition on the "Endeavor" as including thin-paper editions of seven poets, viz., Keats, Shelley, Wordsworth, Byron, Burns, Browning, and Matthew Arnold; also "A Book of Light Verse," edited by R. M. Leonard; "A Century of Parody," edited by Jerrold and Leonard, and eighty volumes of a thin-paper edition of "The World's Classics," each 6 by 4 inches, together occupying less than 4½ feet of shelf-room.

The above enumeration suggests an inquiry which some newspaper, with a penchant for eliciting votes on all sorts of questions, might find it worth while to submit to the public: What books would you take with you on a polar expedition, apart from those required in connection with the work of the expedition?

The question has, of course, presented itself to every prospective polar explorer, and it is interesting to see how variously it has been answered. It is a question of no little importance, because, on the one hand, reading is the one great resource of the polar explorer, especially during the long inactive winters, while on the other the number of books that an expedition may carry is limited by practical considerations. Drygalski, in his narrative of the German South Polar Expedition of 1901-1903, writes entertainingly of the enormous amount of reading done by the members of his party. The "Gauss" had an unusually large and varied library, presented by German publishers and other friends of the expedition, and it was the rule that after a book had been read by one of the explorers it went the rounds of the rest, and then furnished a topic of conversation at table. The specimens of light literature were soon worn to pieces. It is interesting just now to learn that one of the favorite authors in the ship's library was Treitschke, all of whose books were devoured with avidity. Some of the party found works on philosophy most congenial, but Drygalski complains of the meditative and introspective mood resulting from such reading.

Greely records that the Lady Franklin Bay Expedition had an excellent library, embracing, besides Arctic works, encyclopædias, scientific works, etc., about a thousand novels, magazines, and other works of a light character.

In the narrative of Scott's last expedition we find many references to the books carried on the sledging expeditions. "David Copperfield," "The Life of R. L. Stevenson," and "Simon the Jester" (rather an odd assortment) were the favorites of Campbell's sledging party, while Griffith Taylor and his companions took an even more miscellaneous "sledging library" on their westward journey, including Tennyson, Browning, "The Autocrat of the Breakfast Table," a novel by William Le Queux, a number of the *Red Magazine*, and five books in German (two of them mathematical). Taylor says "as a caution to later explorers" that the magazine was easily the favorite, while "somehow we didn't hanker after German." On another sledging journey Taylor's party took Harker's "Petrology," Poe's "Tales," "Martin Chuzzlewit," "The Mysterious Island," a German grammar, and "Incomparable Bellairs."

In some respects the most remarkable of "sledging libraries" of which we have any knowledge was that carried by Alfred de Quervain and his little party of Swiss on their recent dash across the Greenland ice-cap. Each explorer was allowed to take along books up to a maximum weight—necessarily very small—with the result that the library contained only the following specimens of "light literature": A volume of Schopenhauer, a "Faust," a Greek Testament, a "Zarathustra," and selections from Sophocles, Euripides, Molière, Lessing, Goethe, and Ibsen; in addition to which one of the party smuggled along a two-pound volume of Mach's "Theoretical Physics" in his instrument case. The leader records that Schopenhauer's "furious polemics" were found especially refreshing, and that in the tent, at night, whichever of the party happened to be engaged with that cheerful author found it impossible to refrain from reading aloud passages "to which the raging storm furnished a fitting accompaniment." Lessing's "Minna von Barnhelm" must, however, have been the favorite, says Quervain, "judging from the grease-spots." Through a deplorable oversight a volume of Homer (of course in the original), from which much diversion had been anticipated, was left behind on the west coast.

## Infringing Patents Are Often Valid

WE are constantly asked by patentees why the Patent Office gives them a patent which infringes another and earlier patent, and they believe that in giving them a patent under such conditions, for an invention which they find they cannot make, use and sell, the Patent Office has given them an invalid patent, or as they generally put it, "a patent that is no good." They do not seem able to understand that their own patent may be good and valid even though it does infringe a previous patent, and they cannot either make, use, or sell that for which the patent was granted them.

This matter would be clear if patentees understood the law under which patents are granted and the rights which are conferred upon them by the patent when granted.

The law requires that a patent shall be granted for a new and useful invention. Such an invention is patentable, even though it includes as a part something which is patented in a prior patent.

Now one who obtains such a patent should know that he cannot make, use or sell it, provided the prior patent is still in force, without the consent of the owner of the prior patent, for his patent or the patented thing infringes such prior patent.

We believe that much of the confusion arises from the words of the patent grant which purports to confer upon the patentee "the exclusive right to make, use and vend" his invention.

This is *not* what the patent secures to him, but what is given him is the right to exclude all others from making, using or vending his patented invention. This right he may enforce by his patent, even though he cannot make, use and sell it himself.

So that it follows that his patent for a new and useful invention will be given him by the Patent Office, even though it does infringe a prior patent, and also his patent may be absolutely good and valid even though he cannot make, use, or sell his own invention.

## Electricity

**Telephone Fire Alarm System.**—As an emergency precaution the Fire Department of New York city has established a telephone fire alarm system. Should there be a breakdown of the existing fire alarm system a signal will be sent out notifying the police as well as the fire companies, and at once men will be stationed at the fire alarm boxes. Then when a man runs to the nearest firebox to turn in an alarm, he will find someone stationed there who will send in the alarm over the police lines.

**Co-operative Electric Garage.**—The New York Electrical Vehicle Association has opened a new co-operative electric garage. In this venture the Association has been aided by three of the leading makers of electric pleasure cars who have made this garage their headquarters. The garage is operated by the Association and the average cost of keeping a car there is about $45, this including care of the car, charging and boosting. The garage has a floor space of 30,000 square feet. The switchboard has 48 charging outlets.

**A Vibration Electrometer.**—Any alternating current measurement which makes use of a null method requires an instrument which will detect small alternating currents or voltages. For this purpose the telephone is used, being very sensitive between frequencies of 500 to 3,000 cycles per second. However, it is very insensitive at frequencies below 100 cycles and, also, it responds to the harmonics of the current as readily as to the fundamentals. Vibration galvanometers may be adjusted so that any harmonics in the current will produce very little effect upon the deflection of the instrument, but while such instruments are very sensitive at low frequencies, they require an appreciable current to produce a deflection because of their relatively low impedance. Hence in bridges where the impedance of the arms is very high they are not very sensitive. A vibration electrometer is described in Scientific Paper 239 recently issued by the Bureau of Standards in which the impedance is much higher than that of a telephone or vibration galvanometer. It is a modification of a quadrant electrometer. Instead of the quadrant there are four vertical plates while a thin vertical vane of twice the area of a single plate corresponds to the needle of the electrometer. Two plates separated by a narrow vertical slit are in one plane, while opposite them in a parallel plane are the other two plates. Midway between the planes is the aluminium vane suspended by a bifilar suspension. The vane is maintained at constant potential by a battery, while an alternating voltage with the same period as the natural period of the vibrating system is applied to the plates. This sets the vane in vibration and as the forces are small, the suspension is designed so that there will be very little loss of energy, and the instrument is kept in a vacuum.

**A New Rectifier.**—Dr. Saul Dushman, writing in the *General Electric Review*, describes a new rectifier of the hot cathode type which he calls *kenotron*, derived from *kenos*, the Greek for "empty" with the suffix *tron* signifying an instrument. The name gives a clue to the particular feature which has made this rectifier practical. It has been known for some time that a vacuum tube containing two electrodes, one of which is heated, will act as a rectifier. But the apparatus acts very erratically and, furthermore, as the voltage is increased there is a blue glow that grows more and more pronounced and under these conditions the cathode disintegrates, rendering the rectifier inoperative. Investigation has proved that the glow is due to positively charged gas molecules which bombard the cathode and cause its disintegration. But when the vacuum is made more perfect, there is no evidence of a gaseous discharge and conduction occurs only by means of electrons emitted from the hot cathode. As the temperature of the cathode increases the electron emission increases in accordance with a known equation, but above a certain temperature it becomes constant, and this, it has been discovered, is due to a "space charge;" that is, the electrons emitted from the hot cathode produced an electrostatic field which tends to prevent motion of any more electrons toward the anode. It has also been found that with a hot filament, in place of the ordinary cathode, there is no conduction except by electrons. Hence, in the kenotron a filament is used for the cathode, which may be either a straight piece forming the axis of a cylindrical cathode or a V or W-shaped filament placed between parallel plates or headlight filament inside a molybdenum cap. Up to the present kenotrons have been constructed for direct current voltages as high as 100,000, with every prospect of being able to increase the pressure to twice that amount, and the maximum current rectified has been as much as 1.5 amperes. The instrument should be of service in the physical laboratory where small direct currents of very high voltages are often required. It should also be useful for X-ray work and it is not impossible that it might be used for high-voltage direct current transmission. In Europe the Thury system of high voltage direct current has been found to possess many advantages. It will be quite feasible to transmit 1,000 kilowatts with 100 kenotrons working in parallel at 50,000 to 75,000 volts.

## Science

**The Polar Medal** has been awarded by the British government to the officers and men of Mawson's Australasian Antarctic Expedition of 1911-14. This medal was last awarded in 1913 to the members of Captain Scott's last Antarctic Expedition.

**Protecting the Elk.**—The Forest Service reports that it made two "plants" of elk last year; viz., one of twenty-four head on the Colorado Forest and one of twenty-three head on the Sopris Forest. Since the distribution of elk began three years ago, a total of about five hundred head have been planted in eleven national forests by the Forest Service, the Biological Survey, and certain States, in nearly every case with successful results.

**The Exhaustive Study of the Cacti** which Dr. Britton and Dr. Rose have been carrying out for the Carnegie Institution, and to which reference has previously been made in these columns, has now reached the point where the descriptive accounts of most of the genera and a majority of the North American species, including those of Central America and the West Indies, have been drawn up. Dr. Rose spent several months last year collecting cacti in western South America, and this year he expects to carry out a similar undertaking in eastern South America. Dr. Britton's field work last year included extensive studies in Porto Rico and adjacent islands, one interesting result of which was the recognition of the long-lost *Cactus moniliformis* of Linnæus.

**The Bureau of Chemistry and the Fish Industries.**—Through its Bureau of Chemistry the U. S. Department of Agriculture proposes hereafter to devote the same attention to questions of storage, transportation, prevention of waste, and utilization of by-products in the various fish industries which has heretofore been devoted with such conspicuous results, to meat and fruit industries. It will co-operate in this undertaking with the Bureau of Fisheries. Studies of the utilization of wastes from the fisheries have hitherto been confined largely to the manufacture of fertilizers, fish oils, and glue, and have not tended to conserve the food supply. The Bureau has recently paid special attention to the industry of canning sardines on the coast of Maine, and has already brought about a marked improvement of the sanitary conditions under which these fish are packed.

**Death of Prof. James Geikie.**—The announcement is made that Prof. James Geikie, the noted geologist died in Edinburgh on March 2d. At the time of his death he was Emeritus professor of Geology and Mineralogy at the University of Edinburgh and dean of the Faculty of Science. After his graduation from the University of Edinburgh he entered Her Majesty's Geological Survey in 1861, and in 1869 he became District Surveyor. In 1882 he occupied the Murchison Chair of Geology at the university. He was one of the founders and a past president of the Royal Scottish Geographical Society, and an honorary editor of the *Scottish Geographical Magazine*. During his life he was the recipient of many honors, including the Murchison medal of the London Geographical Society, the Brisbane Medal of the Royal Society of Edinburgh and the gold medal of the Royal Scottish Geographical Society. Prof. Geikie was an extensive writer, and a contributor to many publications. Among his books may be mentioned "The Great Ice Age," which came out in 1872, and "The Antiquity of Man in Europe." Prof. Geikie was born in Edinburgh in 1839.

**Invisible Icebergs.**—In a recent communication to the New York *Tribune* Abbot H. Thayer, the artist, asserts that many vessels have been lost by collisions with icebergs because, under certain conditions of sky and light, they were invisible. He cites the fact that on the occasion of the "Titanic" disaster, although the black ship was clearly visible to survivors at a distance of several miles they could not see the white bergs against which they actually heard the wash of the sea. He claims that on a clear starry night the bergs are so nearly the same color as the sky that they are totally invisible, and that the same is the case under many conditions of cloudiness, the only exception being when the side of the berg viewed is in such shadow that it shows black against the sky. In other words, it is impossible to see white against white. We do not see white against black, as is the general impression of the conditions that prevail in the case of icebergs at night. As an experiment he suggests that we view the snow covered roofs of neighboring houses at night, far enough away from artificial lights so that the sky is not affected by them. He asserts that it will be impossible to distinguish the white, snowy roofs, which correspond in color with the iceberg, from the sky. The same result is found when the roofs are observed in broad daylight on a cloudy day whenever the light is uniform. In answer to the criticism of those who say they never saw a berg at night that was the color of the sky the answer is made that this is very natural, because this is the very condition under which the berg is invisible. Mr. Thayer makes the suggestion that a very simple way to avoid the danger of colliding with an invisible berg would be to use a searchlight; the reflection would show up the berg very plainly.

## Automobile

**Armored Automobiles.**—The $50,000 included in this year's army appropriation bill for the purchase of armored cars stimulates inventive manufacturing interests since the development of a satisfactory automobile of this type should lead to large appropriations here as well as to orders from abroad. Capt. John B. Ross, U.S.A., of the Ordnance Branch of the service, is under orders to inspect at Detroit a car built at the plant of one of the large producing companies following the ideas of one of the company's inventors.

**Good Roads Mileage in France and America.**—According to the Good Roads Year Book of the American Highway Association, recently issued, America now has 6,000 miles of more good roads than France, the total for this country now amounting to 31,000 miles. Of this 5,000 miles were built in 1912 and about 6,000 in 1914, making a total of over one third of the entire mileage of the good roads of the country. New Jersey was the pioneer State to provide State aid for public highways in 1891 and Massachusetts and Connecticut soon followed, but it is only during the last 10 years that the State aid policy has been in effect to any considerable extent.

**A New Tell-tale Spark Plug.**—A novel type of spark plug for internal combustion engines has been invented by a British company. The plug has a tubular central electrode, which carries a block of quartz serving the purpose of a window through which one can observe the "color" of the explosion in the combustion chamber. A dark purple spark shows the mixture to be correct; a light blue or white explosion signifies that it is too weak, while a red color indicates too rich a mixture. By simply detaching the quartz "window" and substituting a milled nut, the plug is transformed into a "priming" plug, through which gasoline can be injected directly into the combustion chamber.

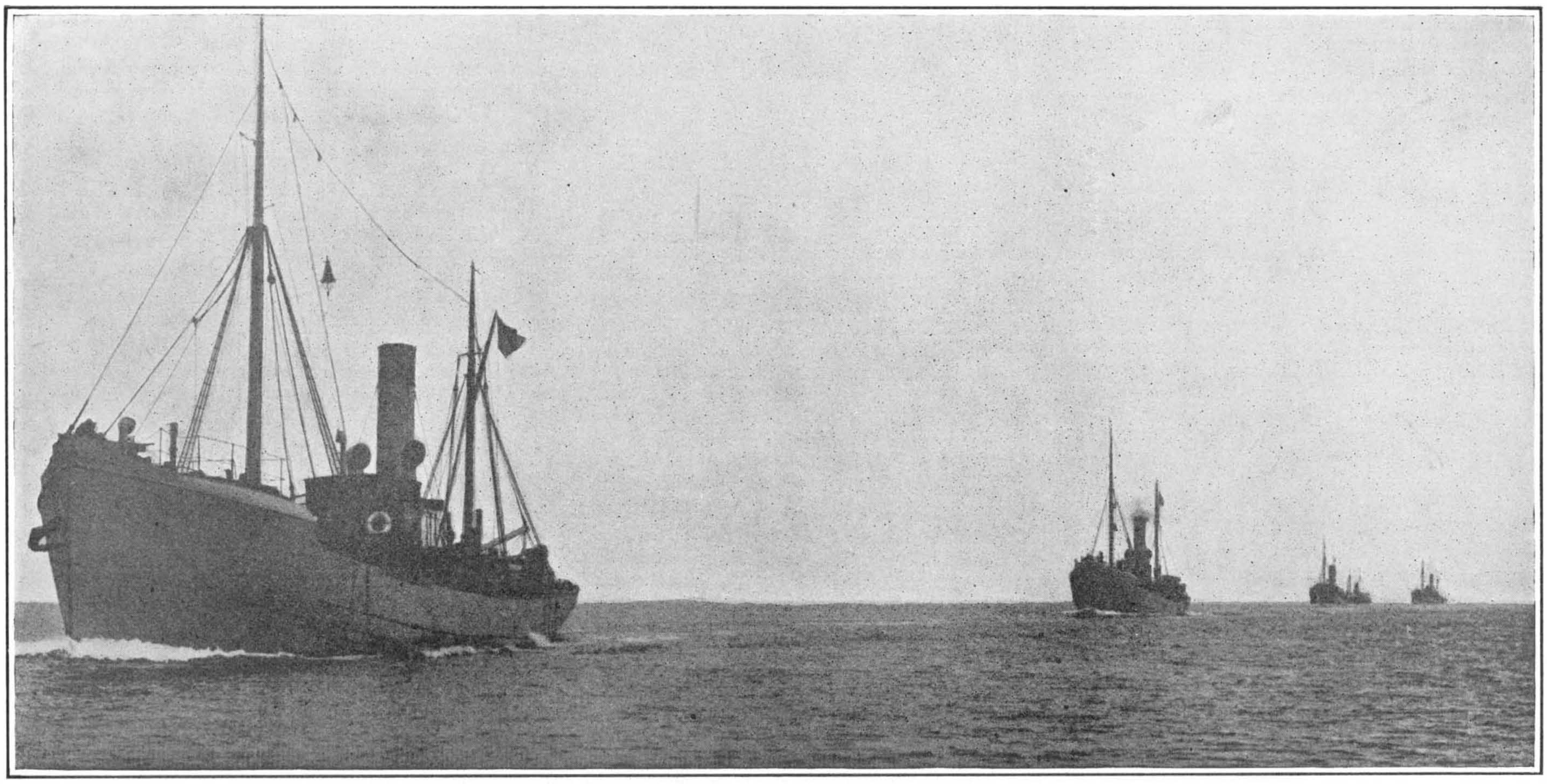
**A Reversible Spark Plug.**—A spark plug which permits the driver to watch explosions through a mica window, is not new. But the manner in which the reversible "twin-spark" plug accomplishes this object is decidedly novel. The plug really consists of two separate and distinct plugs assembled into a single unit. While the "active" end is screwed into the cylinder heads, the outside end also gives off sparks, which are easily watched from the seat, when the hood is raised. If the end of the plug used for exploding the gas mixture becomes fouled for one reason or another, it is necessary only to reverse the plug and to use the other end. The fouled end can be cut out instantly by reversing the terminal contact clip, causing it to touch the plug at the central metallic groove, thereby "short-circuiting" the fouled sparking points. The double spark is said to give a very much better combustion and to enable the motorist to use a leaner mixture in the cylinders.

**Facts Reported in the Good Roads Year Book for 1915.**—More than two hundred million dollars of State appropriations have been expended to January 1st, 1915, and an approximate total of 31,000 miles of surfaced highways constructed under State Supervision since the inauguration of the policy known as "State Aid," according to the Good Roads Year Book for 1915 to be issued in March by the American Highway Association from its Washington office. Only seven States, namely, Florida, Georgia, Indiana, Mississippi, South Carolina, Tennessee and Texas, have no form of State Highway Department whatever, although Georgia grants aid to the counties for road improvement by lending the services of the entire male State convict force. To have State highway departments placed under non-partisan, efficient control; skilled supervision required in all construction work; a proper classification of highways to insure intelligent distribution of improvements; an adequate provision for maintenance of highways from the day of their completion are among the objects for which the American Highway Association is waging a vigorous campaign.

**An Automobile for Railway Use.**—In furtherance of the "safety first" principle, the Atchison, Topeka & Santa Fe Railway Company has equipped its Safety Commissioner, Isaiah Hale, with a 7-passenger automobile so fitted with removable tires as to permit of the machine being run on the standard-gage track of the system. With him in the automobile Mr. Hale carries a phonograph and he operates the car over those stretches of the road in the far southwest where great numbers of the Mexican section-hands, track-laborers and other employees are regaled with a programme of phonographic selections. In this the Spanish tango and Mexican song records predominate. Thus the swarthy men from across the frontier are prepared for the 9-minute "safety talk" in Spanish—the Spanish of the border—which closes the impromptu "concert." This consists of a graphic recital of the disaster which must attend the taking of chances on and about the company's lines and property. Whenever he finds that the Mexican "boys" have a phonograph in their bunk cars, Mr. Hale leaves a set of "tango" and song records, which is sure to include one of the "safety-talks."

# Forcing the Dardanelles

## Further Evidence of the Supreme Importance of the Command of the Sea



**A fleet of British trawlers of the kind now being used by the Allies in mine-sweeping operations in the Dardanelles.**

If the great Mahan were living to-day he would witness, in the so far successful forcing of the Dardanelles by the allied fleet, one more of those striking evidences of the decisive value of the command of the sea, of which the present war has afforded so many.

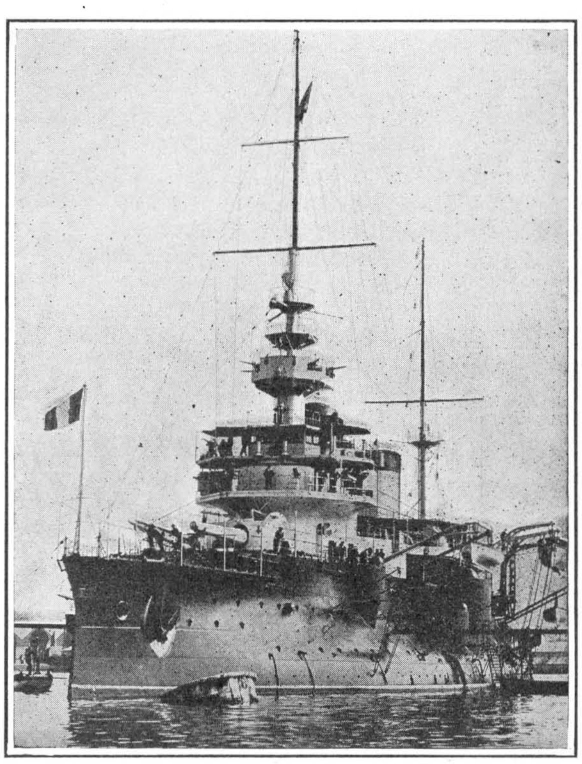
It is quite possible that the ultimate issue of the great conflict will be determined by economic exhaustion, due to the absolute blockade of Germany and Austria by sea and land; and the stupendous operations which are being carried on in the Dardanelles may prove to be the forging of the last link in an unbreakable chain, which, with the capture of Constantinople and the resultant entry of Italy and the Balkans into the war, will extend unbroken from the western coast of Norway by way of the North Sea, the Mediterranean, the Balkans and Russia, to the eastern shores of the Baltic.

Much has been said and written during the past few years about the impregnable character of modern seacoast fortifications against successful attack by water. For reasons which we indicated in our last issue, such as the more accurate range-finding and the more stable platforms of seacoast guns, it has been generally believed that no admiral would risk the loss of ships costing from ten to fifteen million dollars apiece, by venturing within the zone of fire of heavy seacoast guns and mortars. Nevertheless, to-day we see this very thing being done with a deliberation and a success which are equally astounding.

The security of Constantinople from attack by the sea was supposed to lie in the fact that it could be approached from the Mediterranean or from the Black Sea only through a narrow strait, at one point less than a mile in width, which was defended by some of the strongest and most-heavily-armed fortifications in the world. Thus, the Dardanelles, some forty miles in length, are flanked at their entrance by forts on either side, and at the Narrows are similarly protected by a string of forts well supplied with Krupp artillery of from 9.4-inch caliber up to 14-inch. Should both the entrance and the narrows be forced the ships for the next twenty-five miles would be threatened by various redoubts and batteries and, finally, would have to overcome a series of unusually strong defenses where the Dardanelles narrow before opening into the Sea of Marmora.

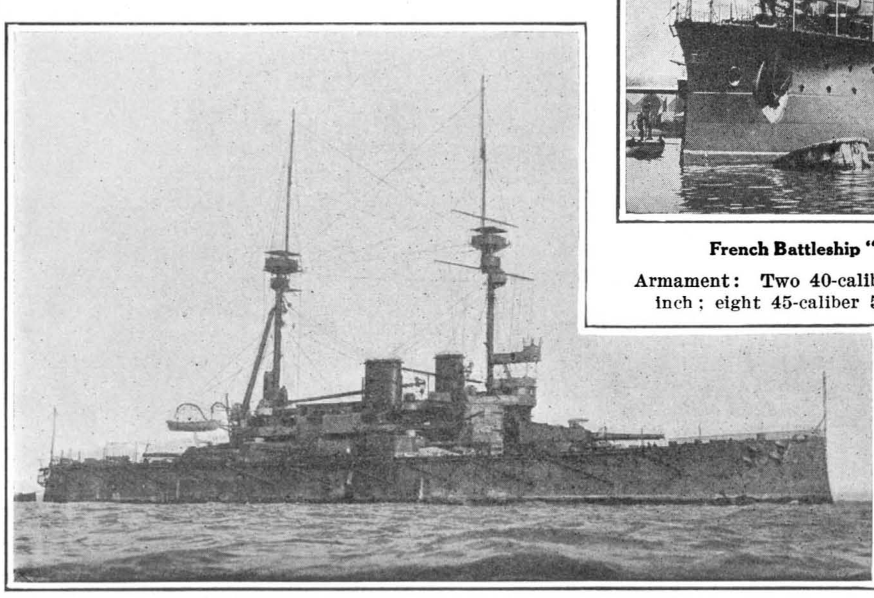
During the first two weeks of operations the allied fleet has forced the westerly entrance of the Dardanelles and silenced some of the heaviest forts at the Narrows. The indications are that this attack will be pushed through successfully. If so, the day when Constantinople will be covered by the guns of the enemy is not very far distant. Now, with Constantinople in the hands of the enemy, the whole Turkish plan of campaign would collapse; for Constantinople is to Turkey what Essen and Westphalia are to Germany. If Holland should enter the war, and the Allies, attacking on the flank, should capture Essen and the great manufacturing centers of Westphalia—the source of the enormous supply of arms, ammunition, and transport for the German army—German resistance would cease automatically. Equally vital is Constantinople, where is situated the Turkish arsenal, to the continuance of Turkish operations.

The collapse of Turkey would set free probably between 300,000 and 400,000 British and Russian troops, for the reinforcement of the allied armies in the east-



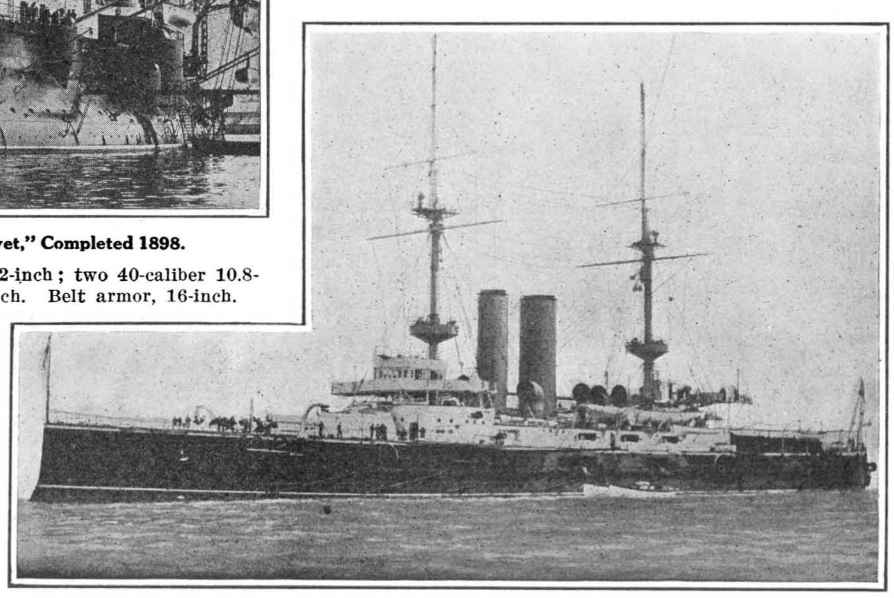
**French Battleship "Bouvet," Completed 1898.**

Armament: Two 40-caliber 12-inch; two 40-caliber 10.8-inch; eight 45-caliber 5.5-inch. Belt armor, 16-inch.



**British Semi-dreadnought "Lord Nelson," Completed 1908. Also "Agamemnon."**

Armament: Four 45-caliber 12-inch; ten 50-caliber 9.2-inch. Belt armor: 12-inch.



**British Battleship "Albion," Completed 1902. Also "Vengeance."**

Armament: Four 35-caliber 12-inch; twelve 40-caliber 6-inch. Belt armor: 6-inch.

**The large fleet of warships attacking the Dardanelles is composed chiefly of old battleships, such as the "Bouvet" and "Albion;" the "Queen Elizabeth," "Lord Nelson" and "Agamemnon" are modern.**

ern and western theaters of conflict. Furthermore, it might well serve to bring Italy and the Balkan nations into the conflict, urged on by their desire to have an authoritative voice in the readjustment of boundaries which must necessarily take place at the finish of the war.

To follow in detail the nature of the operations which are being carried out by the allied fleet we must understand the nature of the defenses which have to be broken down. These are three-fold: First, the heavy, long-range, armor-piercing guns, generally mounted on high elevations; second, the batteries of rapid-fire guns emplaced nearer sea level and the shore, which protect the mine fields and prevent mine-sweeping operations; and, lastly, the mine fields themselves.

The heavy batteries of the forts at the Narrows are armed with guns of from 9.2 up to 14-inch caliber; and the first step was to reduce these guns, if possible at a distance which would place the ships outside of the range of the forts. For this work the British Admiralty designated the most powerful ship of the British navy, the "Queen Elizabeth," which has just been commissioned. This vessel mounts eight 15-inch guns, which fire a 1,925-pound, high-explosive shell with a velocity of 2,500 feet per second. For the purpose of attack, the ship took station off the north coast of the Gallipoli Peninsula near the Gulf of Saros. Between her and the forts, running down the peninsula, was a ridge of hills several hundred feet in height, which of course, shut out the forts from view. The firing was what is known as indirect—that is to say, the gunners could not see the target—and the range, according to the British Admiralty report, was about 11½ miles. The fall of the shell was noted by aeroplanes and by ships at the entrance to the strait and the proper correction was sent to the "Queen Elizabeth" by wireless.

When the heavy guns had been silenced, two semi-dreadnoughts, the "Agamemnon" and the "Lord Nelson," supported by the French battleships "Gaulois," "Charlemagne," "Bouvet," and "Suffren," engaged the forts in the Narrows at from 12,000 to 14,000 yards by direct fire; that is to say, the gunners were able to lay the gun sights directly on the forts.

Following the reduction of the heavy guns, the armored ships were sent in to closer range, where they demolished the rapid-fire batteries of 4, 4.7, and 5.9-inch guns as the case might be, which were mounted so as to cover the mine fields and prevent countermining.

For the work of clearing out the mines the British Admiralty, if we may judge from the dispatches, has sent out with the fleet several of those North Sea steam trawlers of which we have heard so much during the present war, a photograph of a few of which is herewith presented. These vessels, in pairs, drag over the course of the channel to be cleared of mines a series of heavy chains, which engage the anchorage cables of the mines and enable the latter to be drawn aside from the channel, or brought to the surface and rendered harmless by exploding them. Into the channel as thus cleared the fleet moves up, and the process of the reduction of the next fort or series of forts within range is proceeded with.

So interesting is the Admiralty statement of March 8th, giving the details of operations to that date, including the activities of the fleet of seaplanes, that we reproduce it in full:

"The operations at the Dardanelles are progressing and have been favored by fine weather. Admiral Carden reports that on March 6th the 'Queen Elizabeth,' supported by the 'Agamemnon' and the 'Ocean,' began an attack on Forts Hamidieh-i-Tabia No. 1 and Hamidieh-i-Tabia No. 3, marked on the Admiralty map as Forts U and V, by indirect fire across the Gallipoli Peninsula at a range of 21,000 yards, or about eleven and a half miles.

"These forts are armed thus: U with two 14-inch guns and seven 9.2-inch guns; V with two 14-inch guns, one 9.4-inch gun, one 8.2-inch, and four 5.9-inch.

### Battleships Are Struck.

"The 'Queen Elizabeth' was replied to with howitzers and field guns. Three shells from the field guns struck her without causing any damage. Meanwhile inside the strait the 'Vengeance,' 'Albion,' 'Majestic,' and 'Prince George' and the French battleship 'Suffren' fired on the fort at Suan Dere, on the European side, and on the batteries at Mount Dardanus marked F and E on the Admiralty map.

"These ships within the strait were fired on by a number of concealed guns. Fort Rumili Medjidieh-i-Tabia, marked J on the Admiralty map, which had been attacked on the previous day, also opened fire and was engaged and hit by 12-inch shells. The majority of the ships within the strait were struck by shells, but no serious damage was done, and there were no casualties.

"The weather continuing calm and fine on March 7th, four French battleships, the 'Gaulois,' 'Charlemagne,' 'Bouvet,' and 'Suffren,' entered the strait to cover a direct bombardment of the defenses on the Narrows by the battleships 'Agamemnon' and 'Lord Nelson.' The French ships engaged the battery on Mount Dardanus and various concealed guns, silencing the fort at Mount Dardanus. The 'Agamemnon' and the 'Lord Nelson' then advanced and engaged the Narrows forts at from 12,000 to 14,000 yards by direct fire.

"Forts J and U replied and both were silenced after a heavy bombardment. Explosions occurred in both forts. Fort L has not fired a shot since the explosion of the magazine on March 5th.

"The 'Gaulois,' the 'Agamemnon,' and the 'Lord Nelson' were each hit three times by Turkish shells, but the damage was not serious. Three men were slightly wounded on the 'Lord Nelson.'

### Aviators Wounded.

"While these operations were in progress the 'Dublin' continued to attack the Bulair Isthmus. She was fired at by 4-inch guns and was struck three or four times.

"Owing to the importance of locating concealed guns the seaplanes sometimes had to fly very low. One seaplane, whose pilot was Lieut. Garnett and whose observer was Lieut.-Commander Williamson, became unstable on March 4th and dived nose on into the sea. Both officers were injured.

"Lieut. Douglas, reconnoitering at close quarters in another seaplane, was wounded, but managed to return safely. Seaplane No. 172, commanded by Flight Lieut. Bromat, with Lieut. Brown as observer, was hit twenty-eight times. Seaplane No. 7, Flight Lieut. Kershaw and Petty Officer Merchant being the crew, was hit eight times in locating concealed positions.

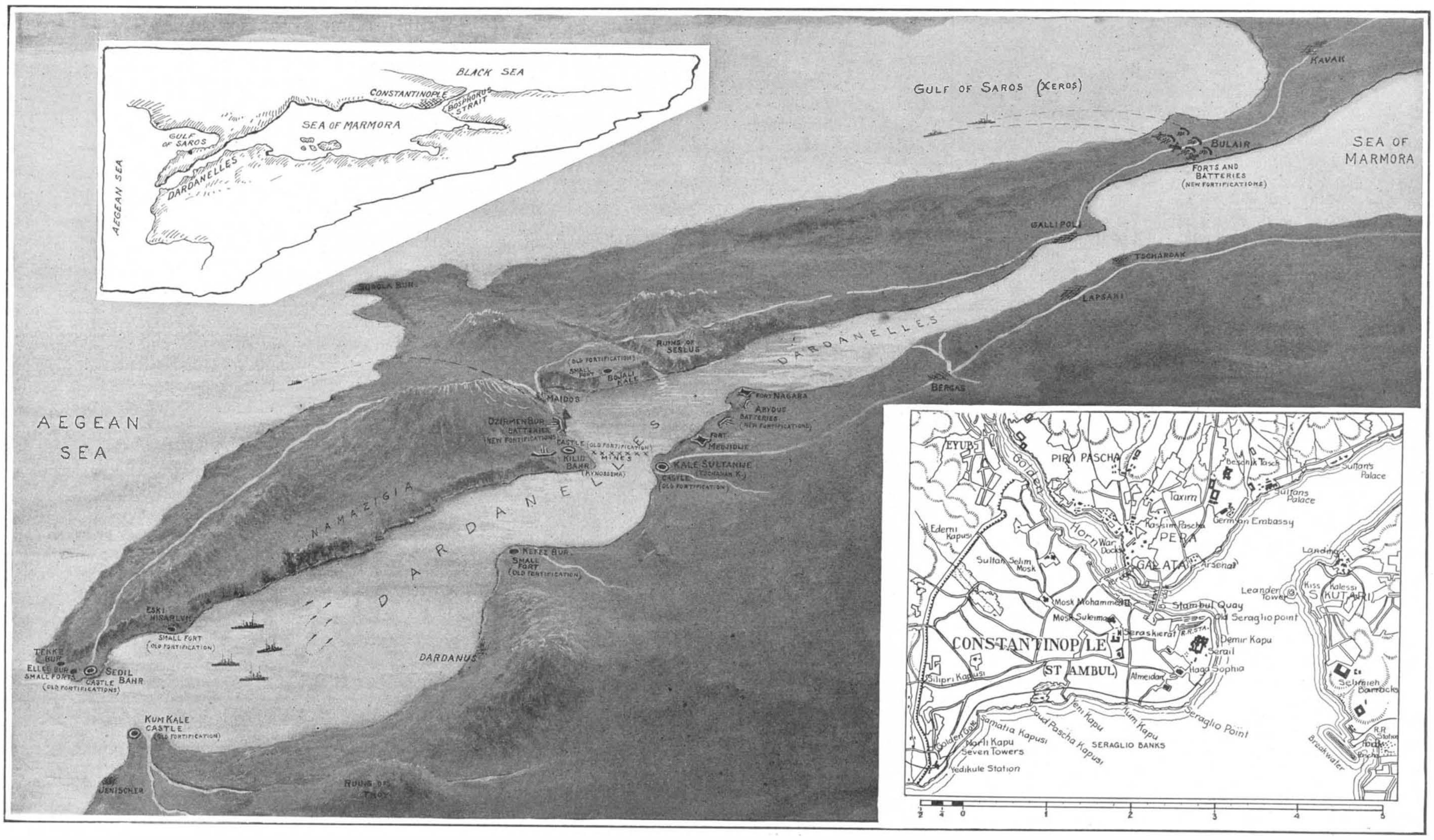
"The 'Ark Royal,' convoy to the aeroplanes and seaplanes, is equipped with every appliance for necessary repairs and for maintenance of the numerous aircraft she carries."

We close this article with the following detailed description of the defenses of the Dardanelles and Constantinople, which is translated from the *Handbuch fuer Heer und Flotte:* The Strait of the Dardanelles connecting the Aegean Sea with the Sea of Marmora is about 70 kilometers long, with an average width of 4 to 5 kilometers. At the western entrance the width is 4 kilometers, at the narrowest portion between Kalid-Bahr and Kale-Sultanije (Tschanak Narrows) only 1,300 meters wide. The European shore is cliff-like in formation, with the exception of the mouths of small streams, and is topped by 200 to 300-meter hills. Large war vessels can easily pass through the straits, but the strong current from the Marmora Sea renders navigation somewhat difficult. The current flows with the velocity of about one and one half nautical miles an hour, but the velocity may attain a maximum of five nautical miles in a strong northern gale.

The fortifications consist of the four Dardanelles castles. Of these, the Sedil-Bahr and Kale-Sultanije were built in 1462 by Sultan Mohammed II; Kum-Kale and Kilid-Bahr, the so-called new Dardanelles castles, were built in 1659 by the Grand Vizier Achmed Köprüli. These are huge masonry structures which have been subject to considerable reconstruction. They are armed with old heavy guns and are partly in ruin. In addition to these there are a few small old forts.

The newer fortifications, batteries, or forts in the Tschanak Narrows were built at the instance of England between 1864 and 1877. They consist of the Namazigia group (three earth batteries southwest of Kilid-Bahr), Dzirmen-Bruus (an earthen battery) on the European side, and Medjidije (a fort) and Nagara (an old stone fort, a newer fort of earth, and two batteries) on the Asiatic side. These works have been armed for the most part with more or less modern Krupp guns and were amplified in 1886 by smaller works. In 1892 the system of obstructions were strengthened with 150 sea mines. The defenses have in recent years been somewhat modernized and provided such modern equipments as telegraph, telephone, etc. The entire fortifications are said to contain 682 guns, about one half of which are more or less modern. The modern defenses are very well equipped and manned, so that a passage could be forced only with heavy sacrifices.

As part of the Dardanelles defenses, the line at Bulair must be mentioned. This is a land defense in the north of the peninsula, 5 kilometers long, consisting of three forts each with twelve to fifteen guns, and connecting lines, intermediate batteries, and advanced redoubts (together over one hundred guns). This line of Bulair protects the mainland from attack.




**The Dardanelles, showing the method of reducing the forts at the Narrows by indirect fire across the Gallipoli Peninsula, assisted by the observation of ships near the entrance to the strait.**

**Plan of Constantinople, showing the formidable character of its defenses.**

# Two Startling Discoveries in Oil Refining

## Dr. Rittman's "Cracking" Process in Which Vapors Are Subjected to High Pressure and Dr. Snelling's Discovery of a Way to Reconvert Paraffin, Vaseline or Any Other Petroleum Derivative into a Synthetic Crude Oil Similar to That from Which it Was Originally Obtained

### Gasoline from "Synthetic" Crude Oil*

**By Walter O. Snelling**

MORE than five years ago I placed a small quantity of a transparent yellow lubricating oil in a bomb-like vessel and heated it to a relatively high temperature. At the end of the experiment I removed the oil from the vessel and was amazed to find that instead of bearing any resemblance to the oil which I put in, it now had the appearance of ordinary crude oil. The green color by reflected light and the rich red-brown by transmitted light were unmistakable. I subjected the material to fractional distillation, and the surprise which I experienced at the *appearance* of the oil, changed to amazement when I found that it yielded, on distillation, 15 per cent of gasoline and 30 per cent of burning oil, and that its construction resembled crude oil quite as much as did its appearance. Furthermore, the gasoline and kerosene distillates which it yielded were of a clear water-white color, entirely without treatment with acid or alkali, and were entirely free from the odor familiar in "cracked" petroleum distillates.

Apparently some remarkable change must come about in the hydrocarbon molecules, when a hydrocarbon body is heated in a still only approximately one fourth full of oil, that does not occur when the same hydrocarbon is heated under similar conditions, except that a greater proportion of the volume of the still or retort is filled with oil. With grave doubts and fears, I placed in my retort some kerosene. If this water-white material, after treatment, should come out green in color by reflected light, and red by transmitted light, then indeed I would be convinced that I was dealing with a true transformation into crude oil. The experiment ended, I poured out from the vessel a liquid which resembled Pennsylvania crude oil so perfectly that when I placed a bottle of the new product by the side of a bottle of the real crude, it was hardly possible to say which was which, by appearance alone. I next melted some paraffin and placed it in the vessel, and after heating under the prescribed conditions, I poured out a thin fluid, suggesting crude oil in every way, which on distillation gave somewhat over 15 per cent of a water-white gasoline, free from "cracked" odor, and other distillates in about the same relationship as in ordinary crude oil.

#### Vaseline, Rod Wax, All Natural Hydrocarbons Yield Gasoline Containing Synthetic Oil.

One after another I tried putting all natural hydrocarbons available to me through this process. Vaseline, rod wax, gas oil, fuel oil, and B. S., all these went into my treating vessel, one after the other. They all yielded materials similar in appearance, odor, and composition. From any of these materials I obtained a synthetic crude oil containing around 15 per cent of gasoline, and other distillates in about the same order as are found in typical crude oils.

This paper makes public for the first time the results of my experiments, and in presenting it I wish to express my indebtedness to Mr. John T. Milliken of St. Louis, Mo., president of the Milliken Refining Company. He was the first oil man whom I met, who was willing to believe that research could really add materially to the oil man's knowledge. He has generously supported the experiments which I am now reporting.

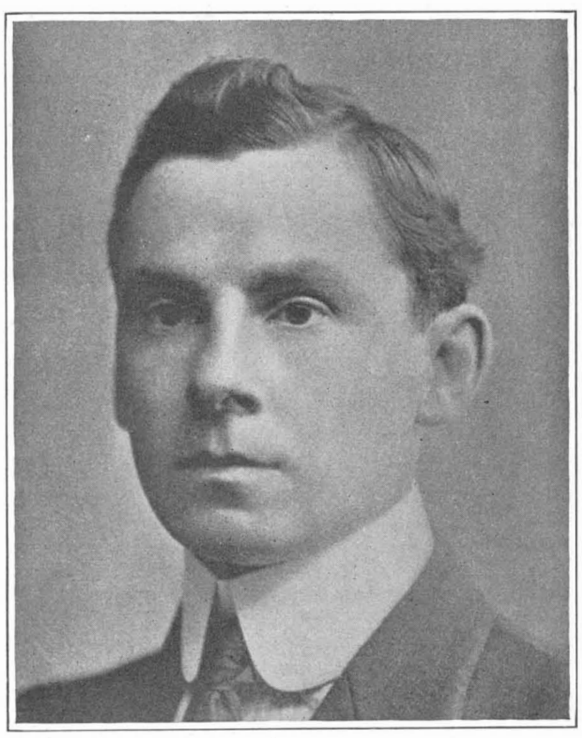
It has long been known that under the influence of high temperature hydrocarbon bodies could be thermolyzed or "cracked," and that by this method low boiling bodies could be produced from hydrocarbons of higher gravity. Indeed, the commercial use of cracking distillation in petroleum refining goes back from more than half a century.

#### "Cracking" and the Snelling Process Compared.

When the limitations of simple cracking of hydrocarbon oils at ordinary pressures were first understood, efforts were made to bring about destructive distillation under increased pressure. Results showing great improvement over those obtained by the simple cracking methods were given by these processes, which seem to have been first made use of by J. Young, and later developed by Dewar and Redwood, and others. Very recently improved processes of cracking distillation under increased pressures have been used commercially by Burton, and are said to have been so developed as to yield products readily salable as substitutes for gasoline.

* Paper read before the American Institute of Mining Engineers.

*Two very remarkable processes for producing gasoline have recently attracted the attention of the entire country—the one devised by Dr. Walter F. Rittman and the other by Dr. Walter O. Snelling. Both are still in the laboratory stage, and much research of a most expensive and extensive character must be conducted before they can be considered commercial successes. The* SCIENTIFIC AMERICAN *here publishes the first exposition of the principle underlying both processes. Mr. Claudy's article appears with the approval of Dr. Rittman, to whom it was submitted before publication, and Dr. Snelling's is an abstract of an unpublished paper read recently before the American Institute of Mining Engineers. After reading the two articles, we cannot but be impressed with the mystery of crude oil. Here is a compound with atoms and molecules so delicately balanced that they can be shifted into new relations merely by changing the pressures to which they are subjected or by changing the volumes employed. Why this should be so no chemist is wise enough to answer. In other words, there is still more empiricism than science answers in petroleum refining. While both discoveries are related to "cracking," Dr. Snelling's is particularly noteworthy in the sense that he can take what may be called a finished product and rearrange its structure so that it becomes practically its own original.*—EDITOR.



**Dr. Walter O. Snelling, who has succeeded in making gasoline from synthetic crude oil.**

It will thus be seen that I cannot claim to be in any way a pioneer in the production of lighter hydrocarbons from materials of heavier gravity. Hydrocarbons have been cracked and broken up into lighter hydrocarbons of lower boiling point, both experimentally and commercially, for a period of over fifty years, and such cracking experiments have been conducted both at normal pressures and under increased pressures.

Apparently, however, the remarkable influence which is played by the ratio of the liquid contents of the vessel to the total volume of the vessel, has been either wholly overlooked, or at least not properly appreciated. It has been wholly through the investigation of the effects of the ratio of the volume of oil, to the total volume of the vessel, that I have developed the process which I am here describing, and which has given the remarkable and unexpected results already mentioned. I believe it is only when these suitable volume relationships are observed that we can get these results within a range of temperature and pressure adapted to commercial development.

#### The Wonderful Results are Obtained Only When Small Quantities are Treated.

Very careful studies made in my laboratory have now proven that, when a hydrocarbon body, such as gas oil, for example, is heated in a vessel which is filled to more than one tenth of its volume with such oil, but such filling is less than one half of the total volume of such vessel, and if then the vessel is so heated that a pressure of say 800 pounds per square inch exists within the vessel, a very remarkable and fundamental change occurs in the hydrocarbon filling such vessel. It is as though the carbon and hydrogen atoms were free to rearrange themselves, and that such rearrangement goes on until a more or less definite mixture of hydrocarbons remains in the vessel. Where the vessel is less than one tenth filled with oil, considerable "cracking" seems to take place and the product is quite inferior. Where the vessel is much more than one half filled with oil, the reaction seems to fail almost wholly, the amount of light products produced being very small. But when the conditions within the vessel, as to amount of filling and temperature applied, are as indicated above, the carbon and hydrogen atoms of the hydrocarbon seem to rearrange themselves to form crude oil and natural gas.

In this rearrangement, not only are low boiling compounds produced from those of higher boiling point, but even the reverse action takes place. In several tests I have obtained from petroleum products of medium boiling point synthetic crude oils which contained high-boiling ends, whose boiling point was considerably higher than any of the constituents present in the original oil used. Apparently the entire process depends upon certain equilibrium reactions, in which constituents of different boiling point tend to be present in a certain very definite ratio, provided the space relationship within the treating vessel is of the proper order. Solid paraffin, of course, contains no constituents that are liquid or gaseous at ordinary temperatures, but upon treatment by this process even this solid paraffin is resolved into synthetic crude oil and natural gas, and the percentage of products of each definite boiling point appears to be in a definite condition of equilibrium. If, instead of starting with paraffin, we go to the other extreme, and start with kerosene, which is entirely free from heavy ends, we will obtain a synthetic crude oil which is much lighter in gravity than that produced from paraffin, but which nevertheless contains high boiling constituents whose boiling point exceeds by many degrees the boiling point of the heaviest product present in the untreated kerosene. Thus, it will be seen that while this process is primarily one in which heavy hydrocarbons give crude oils containing light distillates (this being the main trend of the reaction), yet the process is so essentially one dependent upon equilibrium, that if high boiling constituents are absent, or present in very small amount, the equilibrium will not be satisfied until additional amounts of these high boiling constituents have been produced as the result of the reaction which is going on.

#### Gasoline is Always Contained in the Synthetic Oil.

A residual pressure, after cooling, always exists due to the natural gas formed in the process, and the amount of gasoline in the synthetic crude oil seems to be very constant no matter what hydrocarbon is taken. If is of course evident to the chemist that natural gas and gasoline contain a greater percentage of hydrogen than do heavier oils, and it is very interesting to note that when the charge which is placed within my treating vessel contains a hydrocarbon deficient in hydrogen, the formation of saturated gasoline goes on just the same, and the synthetic crude oil produced carries a "mud" consisting of the carbon which in the rearrangement has failed to find hydrogen. The gasoline produced from materials even highly deficient in hydrogen is quite normal in color and does not appear to be in any way like the "cracked" products which are produced by the thermolysis of oil vapors, etc.

It is of course evident that if putting any hydrocarbon through the process described makes it into a crude oil, it ought to be possible to take any hydrocarbon, and first convert it into crude oil by the process described, then remove the gasoline, for example, or any other constituent, from this crude oil by distillation, and then to subject the residue to a repetition of the process. I have done this many times, and have converted paraffin and other petroleum products almost wholly into gasoline and natural gas. I have obtained from paraffin about 70 per cent of water-white gasoline, the remaining 30 per cent representing the natural gas formed by the repeated action of the process, and some free carbon. From fuel oil, gas oil, vaseline, and similar materials I have obtained from 50 per cent to 70 per cent of water-white gasoline, and samples of

this gasoline, even after standing for a year or two, do not discolor, nor acquire an offensive or "cracked" odor. I wish particularly to note that this gasoline, even when produced, was not treated in any way, and has never come in contact with either acid, alkali, fuller's earth, bone black, or other related materials. In brief, the process which I have described produced from practically any hydrocarbon a material which resembles natural crude oil, and which gives a gasoline which appears equal in quality and appearance to gasoline from natural crude. Both the crude oil produced by my process and the gasoline produced from its distillation possess an odor which is somewhat different from the odor of natural crude oil and ordinary gasoline. This odor, while peculiar and distinctive, is not in the slightest like the odor of "cracked" products, and it is in fact a slightly milder and sweeter odor than that of ordinary oil products. Upon mixing my synthetic crude oil, or the gasoline produced from it, with certain muds and clays, it seems to be altered, and the odor changes and becomes much more like that due to ordinary crude oil.

These experiments which I have described have been wholly of a laboratory nature, and much work remains to be done in the application of the principles which have been discovered, to commercial work on a large scale.

## The Rittman Process of "Cracking"

By C. H. Claudy

THE shortage in dyestuffs founded upon the coal tar industry, as well as the increased consumption of gasoline abroad, not to mention the enormous business in explosives, have all aroused great interest in possible methods of supplying coal tar dyes, gasoline in enlarged quantities, and explosives of all kinds. In many explosives coal tar products are important ingredients. Any process, therefore, which is concerned with coal tar or gasoline, and looks to the preparation of either, is of considerable economic interest in America. A process which concerns both coal tar derivatives and gasoline is, therefore, of double interest. But the ill-considered and misleading statements of newspapers regarding new processes and their possibilities frequently do more harm than good, by prejudicing the scientific world in advance against worthy ideas, when they are presented in a manner which shows at once that impossible claims are being made.

The recent announcement by the Secretary of the Interior of a new process of petroleum "cracking" has resulted in the usual daily press hysteria regarding its possibilities. While refusing to prophesy what the future will develop in the commercial application of his discoveries, Dr. Walter F. Rittman, chemical engineer of the Bureau of Mines, would be the first to decry the many impossible powers attributed to his results by newspapers more sensational than accurate.

### Dr. Rittman's Process is Still in the Laboratory Stage.

Dr. Rittman's processes, which are the result of applications of mathematics, physics, and chemistry to the process of petroleum cracking, were worked out in the laboratories of Columbia University. Showing remarkable results in many ways. they are still in the laboratory stage, and, as all practical chemists know, what happens in the laboratory cannot always be duplicated commercially on a large scale. Dr. Rittman believes that his process is commercially practical, and that it will not only result in an increased production of gasoline at a less cost than at present, but that it will to a large extent relieve the shortage in coal tar dyes caused by the European situation, and in the same way, contribute to the manufacture of those explosives which depend upon coal tar derivatives for their ingredients. That a full-fledged coal tar industry, completely displacing foreign competition, will result from the application of this process commercially, as apparently believed in some newspapers, is an absurdity at which Dr. Rittman would be the first to laugh.

The fundamental difference between the Rittman process and all other processes of obtaining from petroleum those more refined products of use in the arts, is found in its use of the vapor phase rather than the liquid phase of the material which is to be "cracked."

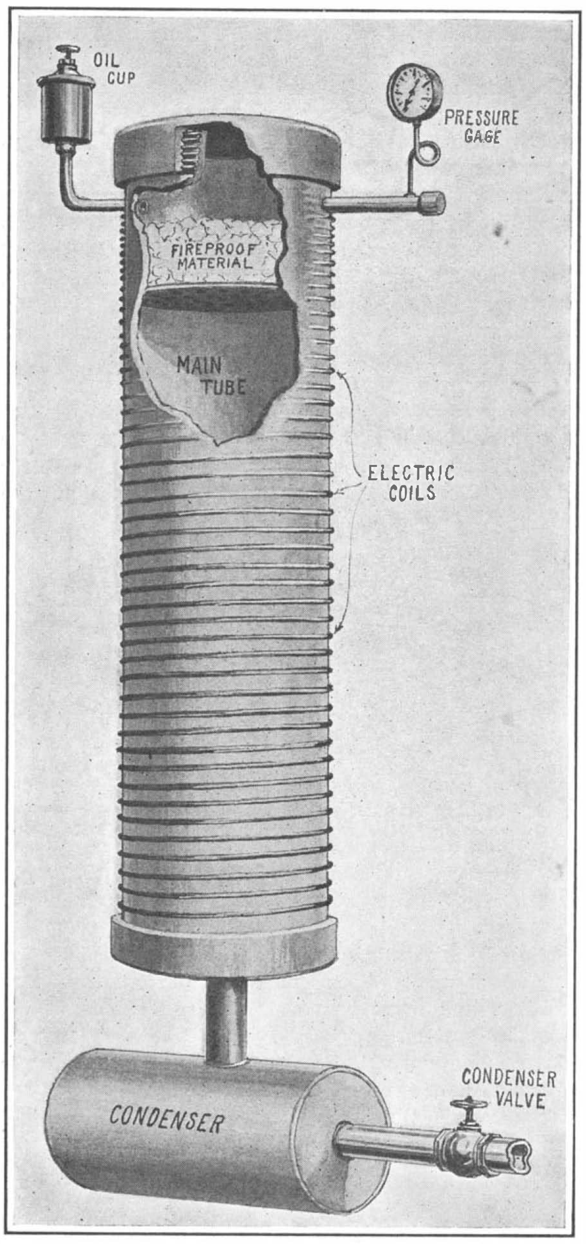
### The Old and the New Process of "Cracking."

From the beginning, the still has been the recognized method of dealing with any treatment of petroleum. When distillation gave rise to the newer process of "cracking" a heavy petroleum distillate to make lighter oils, the use of the still was continued. A certain inertia apparently developed in the chemical engineer's mind which prevented him from thinking of any process looking to the refinement or change of petroleum constituents which did not involve a process of distillation.

The immediate result has been to limit the "cracking" process to the pressures and temperatures which were practical and profitable from the commercial standpoint in the still.

Dr. Rittman attacks the problem from altogether another angle. Knowing that liquids are incompressible, and that, in spite of the application of considerable pressure, they do boil and thus give rise to danger of exploding the still, with the consequent loss of its entire contents, not to mention the loss of the still and the attendant dangers, Dr. Rittman proposed to himself first to convert the petroleum to be treated to vapor. Then, when it was in the vapor or gaseous stage, to subject it to such pressures and temperatures as would result in the production of gasoline, or, pushed further, of benzol and toluol, and the other similar compounds which together form the mother substance, in coal tar, of so many useful products, dyes, medicines, constituents of explosives, etc.

In practice, the apparatus used is represented in the accompanying diagram. A suitable tube of iron, closed at one end and opening from the other into a condenser of appropriate form, has across its upper section a septum, pierced, upon which is placed a layer of lumps of fire clay, balls of iron, or other non-melting substance. Connecting to the main tube through a smaller one is an oil cup so arranged that its contents may drip down slowly onto the layer of fireproof material above the septum. On the other side of the tube a smaller tube leads off to the familiar pressure gage.




**The experimental apparatus of Dr. Rittman.**

Surrounding the main tube is a coil or coils of wire, by which, through the application of an electric current, the tube may be raised to any desired temperature.

The oil dropping upon the heated fireproof material is converted into a gas or vapor. Any solid residue which would normally appear to collect upon the fire brick or iron balls is washed down into the main tube, and thence into the condenser, by the gasoline and gasoline vapor inherent in the petroleum. As the vapor or gas collects in the main tube and is heated by the hot electric coils, it creates its own pressure, which is regulated by the amount of crude oil permitted to flow down, and also by the amount of heat applied. It is further subject to regulation through the valve which leads from the condenser.

### The Advantage of Treating a Vapor Instead of a Liquid.

By treating vapor of petroleum instead of the liquid itself, Dr. Rittman is able to go much farther than can be accomplished by the use of the still. In the still, pressures of 100 pounds are high, and an undue increase of heat after that pressure is reached is usually dangerous. Gas, however, is compressible to a much greater degree than a hundred pounds without danger of explosion in apparatus of the type described, and, in experiments, Dr. Rittman has succeeded in working with a pressure exceeding 500 pounds. With such pressures as this, and with a degree of heat perfectly controllable by the means described, the Rittman process not only delivers gasoline to the amount of from 50 to 75 per cent, but permits him to obtain benzol and toluol at will.

These substances, and others closely allied to them, form that mother substance which, derived from coal tar, is used for making dyes and other materials so much in demand in many arts. It is his production of these in this new method of "cracking" that has caused Dr. Rittman to be so misquoted and so untruthfully advertised in many newspapers which have published a garbled account of the facts as given out by the Secretary of the Interior. There seems to be no question in the minds of those practical chemists who have looked into the matter, that a new principle of petroleum treatment has been made commercially possible, but, as Dr. Rittman himself points out, there is only a belief to go upon, practical applications as yet not having been made. Patents have been applied for which are to be dedicated to the American people, and not held as Dr. Rittman's personal property.

The products of the Rittman process which pass into the condenser are, of course, as easily subjected to further heat and temperature, in the ordinary still, as any other petroleum distillate. The great advantages of the process are safety and speed of operation. Laboratory tests prove the benzol and toluol made synthetically in this Rittman process to be identical with those derived from "natural" coal tar.

Practical tests are to be made in a commercial way of the new discovery in the immediate future, although there is no definite announcement at this time as to who will do it or where it will be done. The development of the new idea in treating crude petroleum in the vapor phase instead of the liquid phase will be watched with interest, not only by the oil industry and its allied commerce, but by all users of gasoline and those to whom the coal tar dyes and coal tar constituents of explosives are of importance.

## The Marble Columns of the Lincoln Memorial

By J. P. Kirsch

WHEN Congress made the appropriation of $2,500,000 for the Lincoln Memorial at Washington, D. C., everyone understood that it was to be something of grand proportions, but few realized the magnitude of this great memorial at that time, although figures were published in papers and magazines throughout the United States. Mere figures, however, are not readily grasped by the average man, and until he actually sees the object it is hard for him to obtain an adequate conception of its dimensions.

On the front page of this issue are some pictures of the huge columns of this memorial in process of being formed. One cannot help but be impressed with their mammoth proportions. These will be the largest columns of their kind in the world. Each block of marble as it comes from the quarry weighs about thirty-five tons, and twelve of these huge blocks are required for each column. There will be thirty-eight big columns in the Lincoln Memorial, and each column will be 46 feet high, weigh 192 tons when completed, and will be valued at $15,000. As the thirty-eight columns will require four hundred and fifty-six blocks of about 25 tons each, the total weight of marble will approximate 11,400 tons. This mass of stone is being shaped into columns at Marble, Col. The complete story of the work done on these columns, after leaving the quarry, is shown in the front page illustrations. First the blocks are sized with wire saws to the required thickness. After that they pass through the barrel saw, where they are cut into drums. The barrel saw is in the shape of a drum, with the lower end open and the lower edge doing the cutting. From the barrel saw the stone drums then pass to large lathes, where they are trued up. The next process is to flute the drum. This is done with carborundum wheels operating on opposite sides of the drum simultaneously, as shown in the photograph. After being fluted, the drums are ready for hand finishing and fitting so that each drum will register perfectly with the one above and below when the column is assembled at its destination.

---

**Franco-Swiss Railroad Connection.**—A piece of engineering work which has an important bearing on international railroad traffic is the completion of the Moutier-Granges tunnel. This will afford a long-desired connection from the east French railroads to the Swiss lines centering at Berne. From here, transit is made by way of the Lötschberg line to the Simplon tunnel and to Italy. The length of the Moutier-Granges tunnel is somewhat over five miles. Work was commenced on November 6th, 1911, being retarded by strikes in 1913 and by the recent mobilization, after which it was taken up again on September 30th, 1914. Drilling work is now completed.

# Saturn, the Most Interesting Planet of the Solar System*

## Its Rainbow Rings and Many Moons

By Abbé Th. Moreux, Director of the Observatory of Bourges

FOR the next few months Saturn will be in a favorable position for observation, and the attention of astronomers throughout the world will be attracted to this most beautiful and most wonderful of all the planets.

That which especially distinguishes Saturn from the other planets is a most peculiar system of thin rings, surrounding it in the plane of its equator. The inner edge is about 7,000 miles from the cloudy surface of the globe of Saturn, and the width of the system is about 40,000 miles.

If these rings were solid, they would form a race track wide enough for five balls the size of our earth to roll around, side by side, without touching.

The plane of the rings is inclined to the plane of the planet's orbit about 27 degrees. It follows, therefore, that in the course of the thirty years required for its revolution around the sun, the rings appear at least twice on edge as seen from the earth. Sometimes they appear as a wide ellipse, sometimes very narrow, and again as a simple bright line, which disappears completely in small instruments. The greatest opening of the rings from our point of view occurred in 1899. Starting from that date, its apparent width diminished until 1907-1908, then began to increase, and reaches its maximum again this year.

This planet with such striking peculiarities has naturally offered to astronomers some of the most complex problems. In fact, as soon as Galileo, in 1610, directed one of his first telescopes toward Saturn, which was then considered the most distant of the planets, he was amazed at its strange appearance.

He was far from suspecting the correct explanation of the phenomena, it is true, for in his small instrument the two extensions of the rings looked like two small round satellites. But, in order to assure the priority of his discovery, he composed an obscure anagram, which, later, was interpreted to mean *Altissimam planetam tergeminam observavi.* That is to say, "I have observed the most distant of the planets to be triple." He compared the two extensions to two servants helping an old man on his way.

In 1612, however, the appearance changed. The rings of Saturn were edgewise toward the earth, and, on account of their slight thickness, were invisible to astronomers, who, at that time, had only imperfect instruments. Galileo was much embarrassed. "Saturn," he remarked, "seems, as in the fable, to have devoured his children." This perplexing disappearance became for him an insoluble enigma, and he died without learning the true explanation.

Some years later, Gassendi again observed "the triple star," as he called it, but it was not until 1655 that Huyghens discovered the ring and solved the mystery. At least, he solved the problem which presented itself to Galileo, but with the increase in size and quality of telescopes new difficulties arose.

In 1675, Cassini discovered that the ring was not single, but was divided into two parts by a dark line, and to-day, with our more perfect instruments, we can distinguish a dozen concentric circles all differing in size and brightness. Still further; spectral analysis has shown that with the most powerful telescopes, we ought to recognize thousands of luminous bands, all revolving separately and each at its own special rate around the giant globe.

As to the nature of the rings, up to 1850 no one had ventured to express an opinion. In that year, Bond, a young American astronomer, announced to the world a sensational discovery. While observing Saturn, one evening, Bond discovered that one of the rings was not perfectly opaque. The disk of Saturn was visible through it. The ring, therefore, must be made up of particles of dust, held in position by their common attraction, millions of little satellites, which have not been able to reunite with the central sphere. The fact that the different bands of particles reflect different amounts of light from the sun will explain all of the observed phenomena.

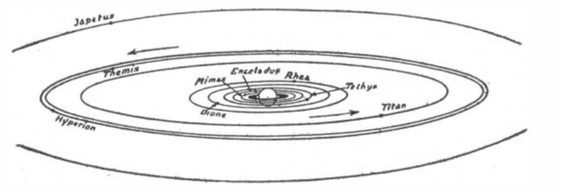
This meteoric theory of the rings is the only one that can possibly explain their existence, for, according to the law of gravitation, it is certain that a solid or liquid appendage of this form would be unstable, and would break up and fall back upon the planet.

This meteoric structure, however, does not guarantee the ring against disaggregation, and what astronomer has not dreamed of being on the watch, some day, and observing a part of the rings breaking up and falling back upon Saturn with a terrible crash!

This hypothesis was considered less chimerical when, in 1851, Struve, after a series of measures, startled the scientific world with the incredible news that the diameter of the ring system appeared to be diminishing, and that the rings were approaching the ball of the planet. "Three centuries hence," said Struve, "the rings of Saturn will have disappeared, buried in the mass of the great sphere which is drawing them in." Modern measures do not confirm his idea, and astronomers to-day assert that, if there is any change in the dimensions of the rings, it must be periodic. The whole system may act like an elastic girdle. Between the rings, the dark intervals must be constantly changing. Only the large divisions have a relative stability, due, without doubt, to the presence of the satellites. We have a striking illustration of the influence of the latter upon the distribution of matter in the apparent gaps in the distribution of the asteroids, gaps which occur at places where the period of an asteroid would be commensurable with that of Jupiter.

The luminous ring surrounding Saturn is not the only peculiarity of this remarkable planet. Of all the planets Saturn has the greatest variety, and the largest number of satellites. In 1655, Huyghens discovered the largest, Titan, whose dimensions are comparable with those of our moon. Between 1671 and 1684 Cassini discovered four; in 1789, William Herschel added two more; and in 1848 Bond announced the eighth, Hyperion.

Thus, within two centuries eight satellites had been detected, revolving around the planet, but this number was not increased until recently, when the application of photography brought the list of recognized satellites up to ten. Themis, the tenth, discovered in 1904 by W. H. Pickering, is a tiny little moon not over thirty miles in diameter. It has taken its place in the middle of the family, while Phoebe, discovered by the same observer, revolves outside of all of the other satellites, and greatly extends the dimensions of the Saturnian system.




Orbits of the nine inner satellites of Saturn. The first four satellites are much nearer to Saturn than the moon is to the earth. Mimas is nearest of all, and Phoebe the most remote. The latter is not shown on the diagram. The extreme diameter of the Saturnian system is 16,000,000 miles.

Iapetus, formerly the most distant, revolves around Saturn at a distance of about two million miles, but Phoebe describes an orbit the radius of which is eight million miles. Saturn and its cortege of ten moons occupy more than thirty times the amount of space required by our earth and its modest satellite. The Saturnian family is, in fact, a reproduction on a small scale of the whole solar system.

We shall leave to the astronomers and authors of cosmogonies the discussion of the formation of this distant world system, but we cannot fail to mention a theory, which has received some approval, of the birth of the rings.

If a globule of oil is dropped upon the surface of a liquid of the same density (for example a mixture of alcohol and water), and if, by means of a needle, a rapid motion of rotation is imparted to the globule, the spherical mass will flatten out, and a ring may detach itself from the equatorial region.

This very suggestive experiment, due to the Belgian physicist Plateau, is still cited in books on cosmography, to illustrate by a concrete example the theory of the formation of the rings of Saturn. Now from the point of view of mechanics, if this actually happened, there would necessarily result an acceleration of rotation of the globe after the departure of the ring. But experience, or rather observation, shows just the opposite. The ball of the planet rotates upon its axis in 10 hours 14 minutes at the equator, while the inner edge of the bright ring completes its revolution in 7 hours 12 minutes, and the inner edge of the crape ring, in only 5 hours and 45 minutes.

Since they turn faster than the planet, the rings can never have formed a part of the sphere which they surround. They must have come from the outside, possibly from some satellite, spoiled in the making, so to speak; fragments of some disrupted mass, which have never been reassembled.

What will become of this curious formation? According to Clerk Maxwell, the rings have only a temporary stability, and a day will come when rapid disaggregation will begin on both the inner and the outer edges. That time has not yet arrived, although different observers have noted some changes along the edges of the rings. I, myself, during the year 1914 (and also in 1913) discovered some gaps in the inner dark ring.

Modern astronomers have weighed all of the planets. Saturn proves to be the lightest. Placed upon a vast ocean, it would float like an ordinary cork. The ball of Saturn is merely a mass of hot gas, the temperature of which is equal to at least 800 or 900 deg. Cent. Organic life cannot exist in its boiling hot atmosphere.

As seen from the equator of the planet, the ring rises into the heavens like a luminous arch, perpendicular to the horizon on each side. On account of its slight thickness it would appear as a thin band of gold dividing the celestial vault. But if one should proceed toward either pole, the ring would appear to widen out, and from the hemisphere illuminated by the sun, it would show various shades and constantly changing forms. Sometimes the shadow of the planet would be projected upon some part of the ring, and would add to the novel aspect of the scene.

Here and there through the wider spaces between the rings or through their thinner portions one might see the sky, studded with stars. Up there would be seen the same constellations that we see from the earth; the Great Bear, near the north pole, blue Vega, and red Arcturus, but the presence of so many moons, showing various phases, would add a weird touch to this remarkable picture.

What a shame that there are no living beings on that distant world to enjoy that strange fantastic illumination and the fairy scene revealed by those celestial lights! But in the boundless space of time years count for little, and among the millions of worlds very few are chosen to be the abode of life. When, for example, in the distant future, Saturn shall have cooled somewhat and a crust formed on its surface solid enough to support living beings, by that time the sun will already have begun its decline. Even to-day it imparts to Saturn a maximum temperature of only 176 degrees below zero, Cent., and from Saturn its disk appears only about one tenth as large as it appears from the earth. But, on the other hand, looking back into the past, when Saturn was still a self-luminous star, why could it not have played the part of sun to its own satellites.

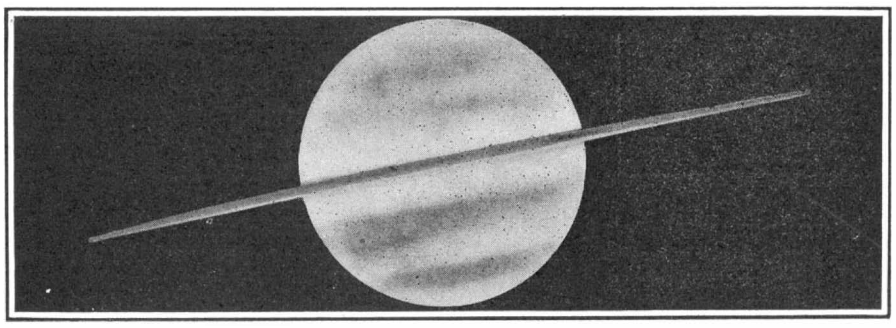
From Titan, the planet would appear as a disk ten times as large as the sun looks to us, while from Mimas, the nearest satellite, Saturn would appear as a great luminous area, 38 degrees in diameter, sixty-seven times greater than the sun, as we see it. Our cover design pictures the planet as it would appear if it could be seen from its moon Titan.

If one can imagine that there are intelligent beings up there to behold those imposing celestial scenes, for them Saturn would be the center of the universe, and they would little suspect that at this moment dwellers upon the earth, a little insignificant point of light, are speculating in regard to their existence.

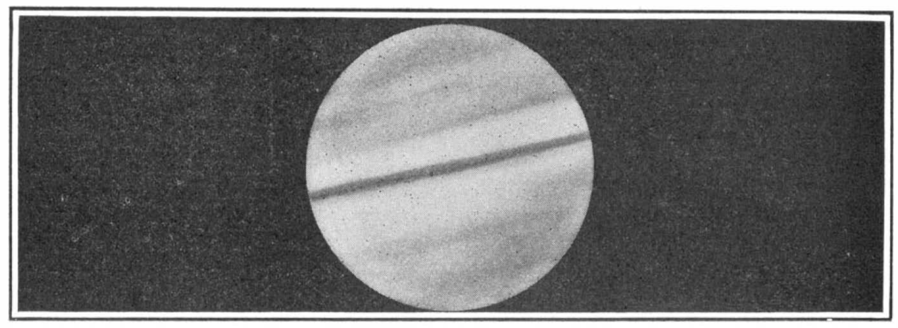
* Translated for the SCIENTIFIC AMERICAN from *La Science et La Vie.*

### Cleaning Automobile Motors With Denatured Alcohol

MOTORISTS are only too familiar with the hard layer of carbon which, with the lapse of time, forms a tenacious coating on the sides of the cylinders and pistons of motors, so as to seriously interfere with their proper functioning. To get rid of this, says *Cosmos*, it is necessary either to scrape the interior of the cylinder, which necessitates complete dismounting, or to employ the oxygen process, which is much easier and more effectual, but is not at every one's command. Our colleague *Omnia* announces a new method, which can be made use of by any one, and without special apparatus—cleansing by alcohol. While the motor is still quite hot we introduce into each cylinder, by the aperture in the spark plug, for example, a glassful of denatured alcohol (a wineglassful for small bore and an ordinary glass for larger bore). The motor is then turned rapidly by hand to distribute the alcohol to all parts of the explosion chamber. It is then allowed to stand for an hour or two, when the operation is re-

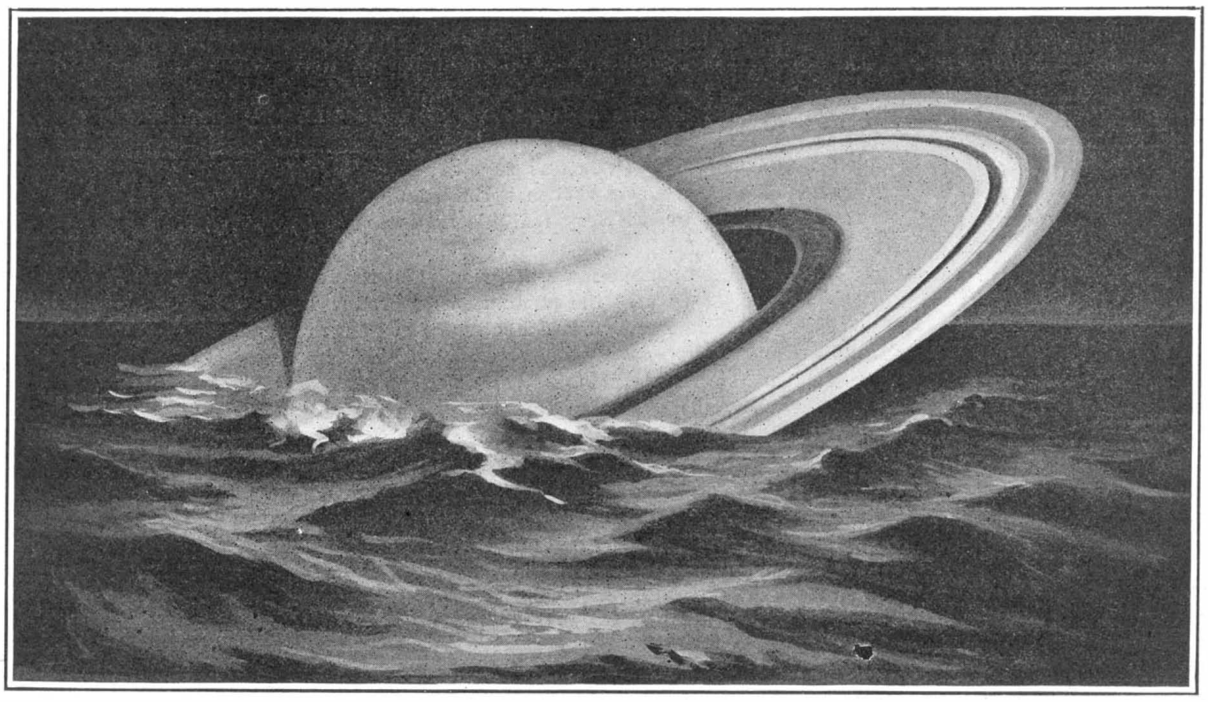


The ring appears here as a mere thread of light.



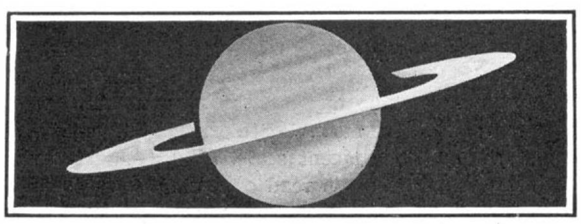
1907 the ring of Saturn was invisible in small telescopes.

peated to make sure the action is complete. The rôle of the alcohol is to dissolve the smut, the bituminous products which cling to the walls of the cylinder; those particles of carbon which are not dissolved, but are thus deprived of support, become detached. The motor is then set going, and there issues from it a dense smoke with which solid particles are mingled. This does not, perhaps, give the absolute cleanliness of the oxygen method (previously described in *Cosmos*), but such as it is it largely suffices to enable a motor to resume normal functioning. Since this method of cleaning is extremely simple it is a good plan to make use of it regularly at the end of every three or four thousand kilometers of travel.

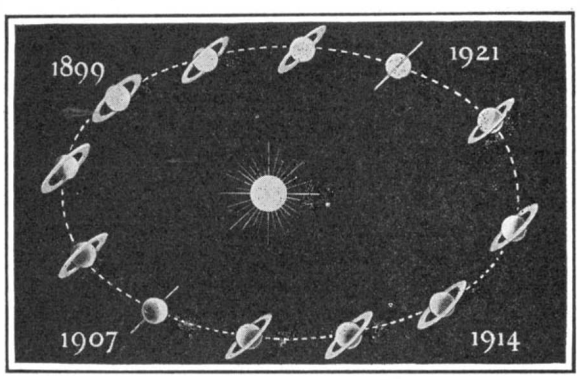


Saturn is the lightest of all the planets. Placed in an ocean large enough, it would float like an ordinary cork.

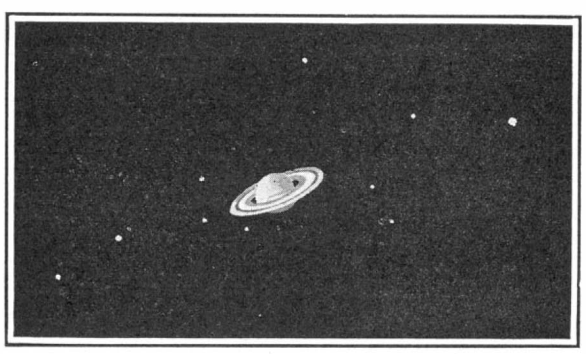
**Foreign Patent Doings.**—The Belgian government has been a migratory institution for some time, and the various practitioners before its departments have been traveling with it. Some of these attorneys have traveled from Antwerp to Ostend, and thence to Havre; while a few have established branches in Holland, according to advices they have sent to their correspondents in Washington. The German Patent Department, in Berlin, has been practically stripped of all its able-bodied clerks, the army having claimed their services, and the force remaining is only sufficient to file patent applications.



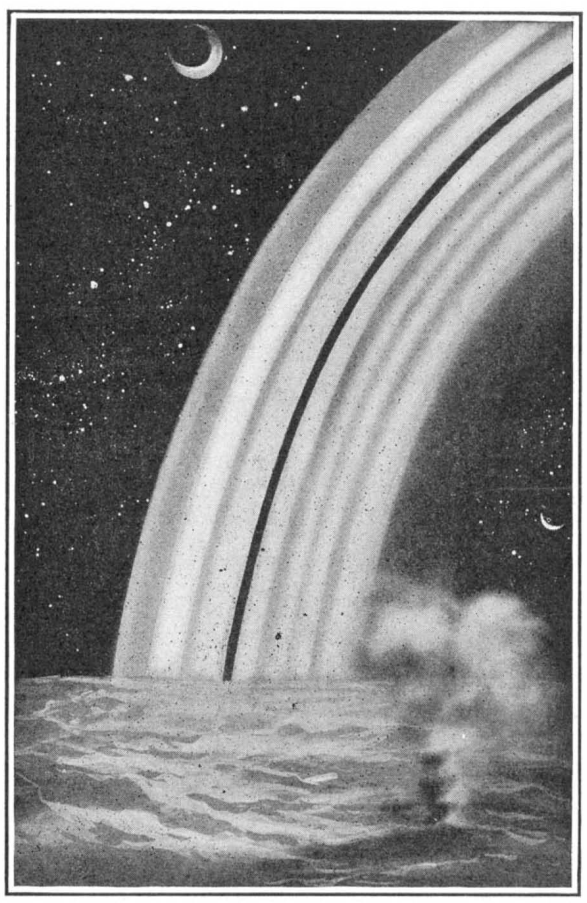
In 1909-1910 the ring of Saturn resembled a very narrow ellipse.



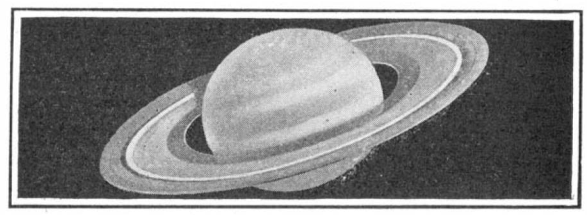

Saturn as seen from the Earth in different parts of its orbit.



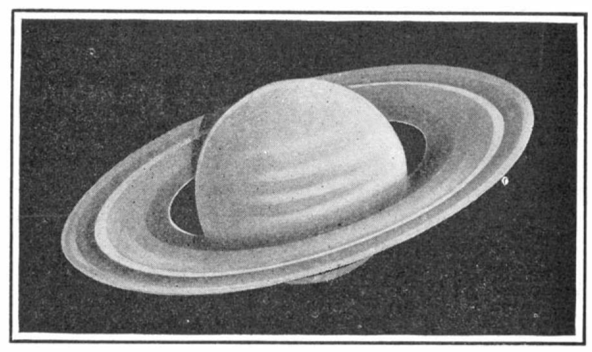
Saturn and its principal satellites.



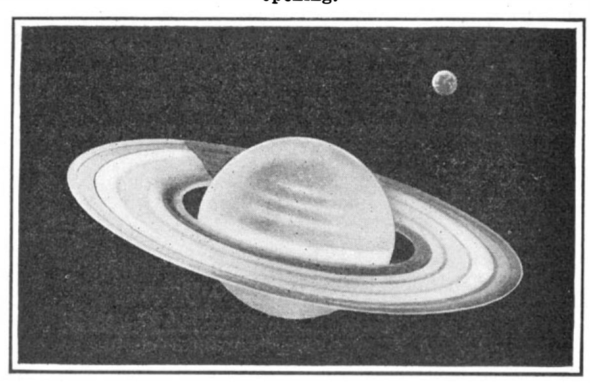
When observed from a point near the equator of the planet, on the side toward the sun, the ring would appear in the heavens like a great luminous arch, showing different colors and changing forms. This ring must be made up of particles of dust held in position by their common attraction. They are, therefore, millions of little satellites unable to reunite with the central sphere.



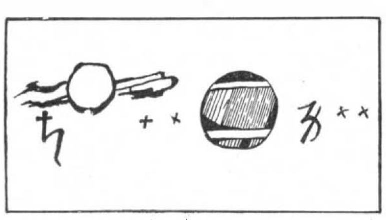
In 1911-1912 the perspective of the ring was a wide ellipse.



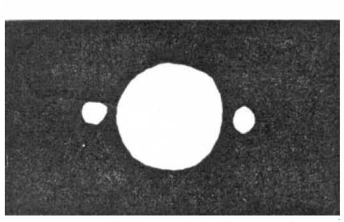
This year the ring of Saturn presents its maximum opening.



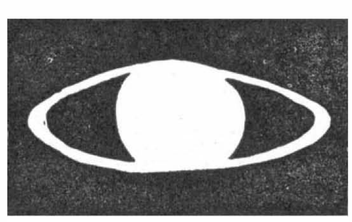
Saturn is almost 813 times as large as the Earth.



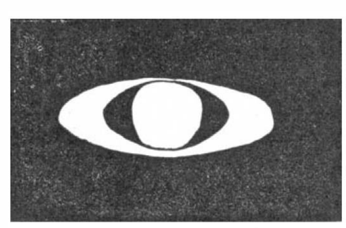
Jupiter with its satellites and Saturn, by Huyghens.



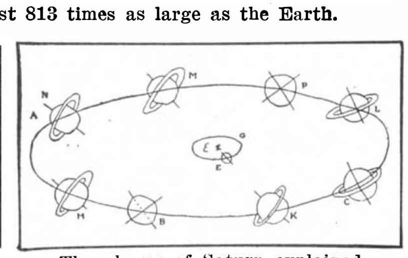
Saturn, triple (Gassendi, 1633).



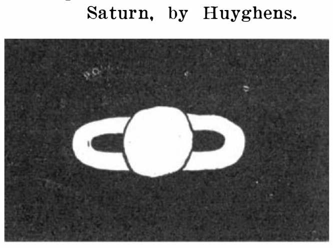
Saturn (Riccioli, 1650).



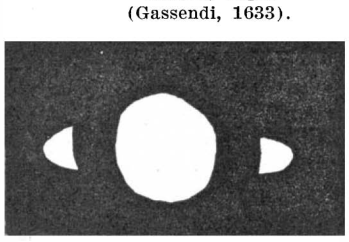
Saturn with two anses (Gassendi, 1636).



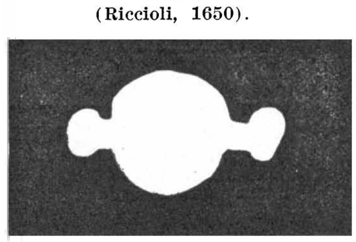
The phases of Saturn explained by Huyghens.



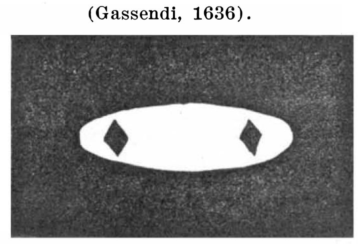
Saturn (Gassendi, 1651).



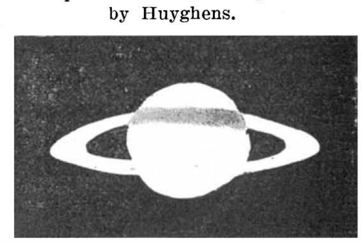
Saturn, triple (Hévélius, 1645).



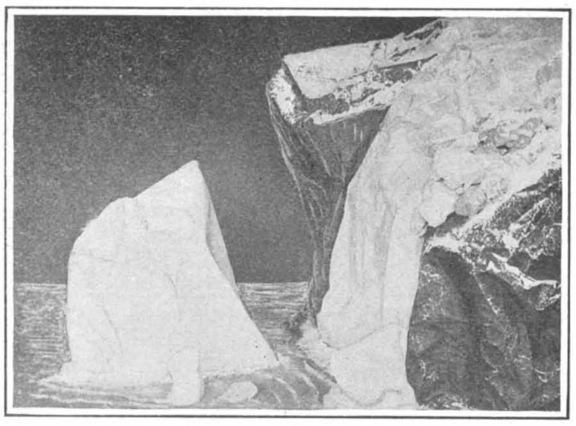
Saturn with two arms (Hévélius).



Saturn (Gassendi, 1646).



Saturn (Huyghens, 1657).

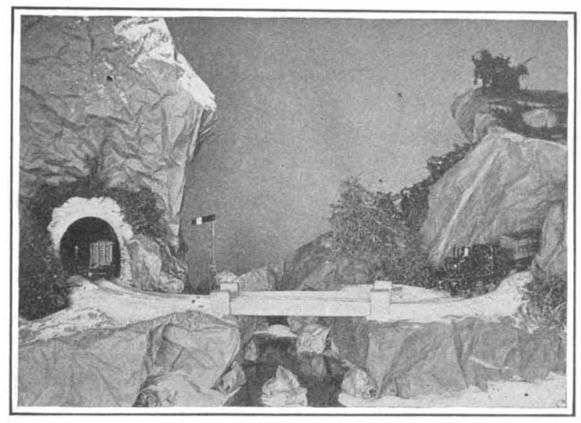


Demonstration of the birth of an iceberg.

# Table-Top Geography

## Hints on the Construction of Simple Models

By Percy Collins



Model illustrating salient features of a railroad.

ALL experienced teachers must often have felt the difficulty of ascertaining beyond doubt that their class of young students has really comprehended the facts of geography which have formed the subject of the day's demonstration. The various points have been explained with all possible lucidity, while each verbal description has been supplemented by such pictures and diagrams as the equipment of the school, and the wit of the instructor, have rendered available. The answers of the young folks *seem* to indicate that their minds have indeed achieved the desired advance in knowledge. But do they really understand? This is the question that continues to haunt the conscientious teacher, who is only too keenly alive to the obstacles which confront the youthful traveler along the paths of learning. Take, for example, such commonplaces of geographical expression as "cape," "isthmus," "straits," or "delta." If he is to grasp the full significance of these terms, the country-bred child must evoke a fund of imagination out of all proportion to that which he may reasonably be assumed to possess. Of course there are plenty of keen, 'cute children about. But it is the dullards who set the pace of the class, and consequently it is with them that the educational expert must primarily concern himself.

Short of showing children the actual things about which we are speaking, models are undoubtedly the best means of setting their intelligence to work. But the best equipped school in the country would probably be nonplussed if asked to back up by a model every fact set forth in its geographical text-book. Yet there can be no question that this is the ideal method.

Considerations such as these lend special weight to the counsels of Mr. W. Fortune Fowler of London, England, who is the inventor of what has been called the "geographical toy." As the result of long experience he has come to the conclusion that every teacher should be capable of assuming the role of model-maker at pleasure; and, further, that in this matter the teacher should acquire the resources and deftness of the "quick change" artist of the vaudeville stage. The teacher should have at his disposal an accumulation of odds and ends capable, at short notice, of being pulled, or twisted, or pinned, or patted into shapes suggestive of the various types of scenery presented to us by the earth's surface. The aim is to make geography so real and clear to the child that it can without difficulty, and with that keen enjoyment which is the best spice for mind-hunger, comprehend such things as latitude and longitude, time and seasons, land contours, the flow of rivers, and how mankind, by his engineering feats, has altered Dame Nature's antiquated arrangements to his own advantage.

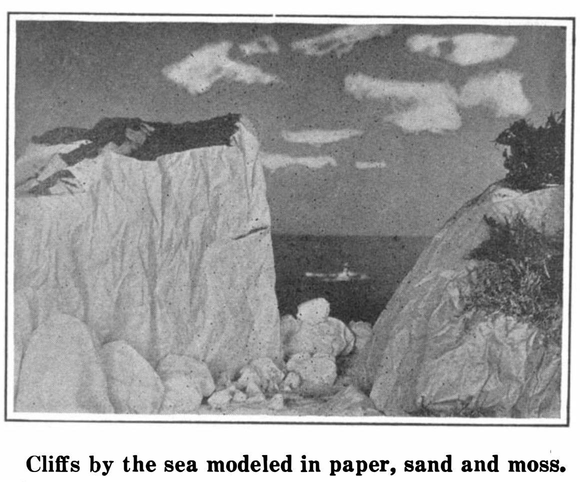
The apparatus and materials necessary for attaining these results are so simple that anyone can procure them. First there must be a large table having a top that may be scratched or punctured with impunity, and stout, rigid legs. This must be placed in a good light before a neutral-tinted (preferably bluish) background, which may be either a wall, or a screen specially prepared for the purpose. The table, which is to be used as a kind of stage, should not be close up to the wall or screen, but about two feet away from it, as the operator will have occasion to pass frequently to the rear of his model when the latter is under construction.

Among the more important materials for impromptu modeling are plenty of old card and thin wooden boxes, large sheets of paper of various colors and thicknesses, sand or dry mold, paint in powder to be mixed with fine sand in different shades of color, and a liberal supply of glass-headed pins such as may be purchased at any drapery store. Besides these things it is well to have at hand a miscellaneous collection of oddments comprising bits of broken glass, sheets of cotton-wool, plaster of Paris, sawdust, a sheet or two of plate-glass, some coarse gravel, and, in fine, anything else that seems likely to prove of service. Moss, by the way, should be kept in two forms, first in its ordinary dried state, when it may be used to represent clumps of trees or dense thickets, and secondly in a finely powdered condition. This powdered moss is easily made by rubbing dyed moss (which is sold for decorative purposes) through a sieve. When sprinkled upon any surface it imparts to it a very realistic appearance of close-growing turf.

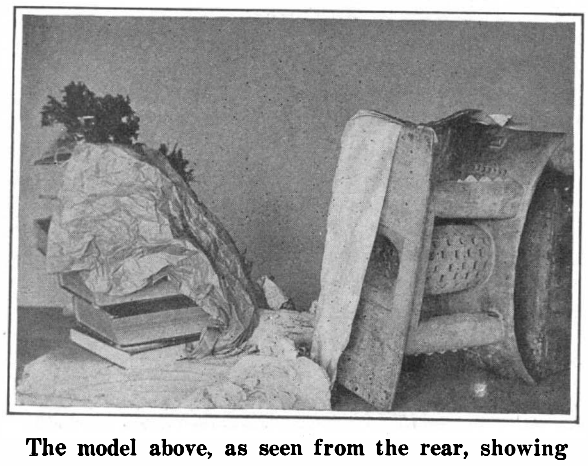
By means of these simple materials wonderful results may be gained, as witness the photographs reproduced upon this page. In one instance a companion picture shows the actual appearance of the modeled cliffs as viewed from the rear. This indicates the simplicity of the method, and the rapidity with which a desired effect may be achieved. The cliffs are really nothing more than sheets of appropriately colored paper pinned around piles of books, boxes, etc. The addition of a little powdered moss, colored sand, and a number of crumpled paper boulders completes the foreground, while a sheet of green-blue paper, a pictured ship, and some clouds of cotton-wool make a pleasing background.

In another instance the object of the model is to display some of the salient features of a railroad as governed by the character of the country through which it passes. To the right a train is issuing from a deep cut, whence it will run along an embankment, to a bridge across a rocky river. Its further progress is barred by a signal, which protects the rear of another train, which is disappearing into a tunnel on the observer's left. Here, also, crumpled paper, moss and colored sand are the chief materials employed; but a sheet of plate-glass has been used to simulate water, while a child's clockwork railway has also been pressed into temporary service. A third example is designed to illustrate the formation of an iceberg. Cliffs of dark brown paper bound the deep gully through which the glacier creeps to the sea, and a white paper berg is represented as having just broken clear of the glacier's foot. Paper of different colors, a few strands of cotton-wool for breakers, and a little sprinkled plaster of Paris, are the sole ingredients for this magical result!

With a little practice, these geographical demonstrations can be arranged in a surprisingly short time, varying from ten to fifteen minutes (as in the case of the iceberg) to perhaps half an hour for an elaborate scene like the railroad. The aim should be to gain the best possible effect with the least possible expenditure of time—though there must be no skimping, since children are critical in a high degree, and will be quick to recognize any incongruity. It will be found a great advantage if some kind of frame, or proscenium, can be arranged through which the model can be viewed. In this way the attention is concentrated, and a more realistic effect is produced. Moreover, for their own good the children should be encouraged to make suggestions, and to help in the preparation of the models, the teacher, however, being always at hand to make his guiding influence and personality felt.



Cliffs by the sea modeled in paper, sand and moss.



The model above, as seen from the rear, showing improvised apparatus.

### A Slide Rule With Radical Improvements

MANY important improvements are to be found in a slide rule recently put on the market, which enlarges its field of usefulness materially. Not only will it perform every operation of the common slide rule, but it will add or subtract as well. The "direct reading" feature of the instrument is another radical improvement; an opening known as a "keyhole" is cut through each of the fixed scales, and through these openings appear red letters marked on the sliding scale. A table on the back of the instrument shows what problems may be solved by setting the sliding scale at the different positions indicated by the red letters. For instance, with the slide set so that the letter *O* appears in the keyhole of the upper scale, one may read cubic inches on one of the movable scales, and the equivalent cubic feet on the adjacent scale. By setting *g* under the other keyhole we can read on one scale the head of water in feet, and on another the corresponding pounds per square inch. In a similar manner the answers to over a score of problems that are constantly being met by engineers may be read off directly. Still another feature makes this slide very useful to electrical engineers, for it supplies a complete wire table. Knowing any one of the following values, the other five may be read off, viz: diameter in mils, area in circular mils, square mil area, pounds per thousand feet, resistance in ohms per thousand feet, size wire B. & S. gage. These and many other problems too numerous to describe in this short note may be solved at a glance with this slide rule. The inventor of it is George W. Richardson, ex-chief electrician of the U. S. Navy.

### Trade-marks in China

THE protection of a trade-mark owned by a foreigner is one of considerable difficulty in China, as "extra-territoriality," with all its attending complications, exists there, consequently foreigners residing in China who infringe a trade-mark are subject only to the laws of their respective countries. There are, therefore, no uniform laws as to trade-marks or any other property rights to which non-Chinese residing in China are amenable.

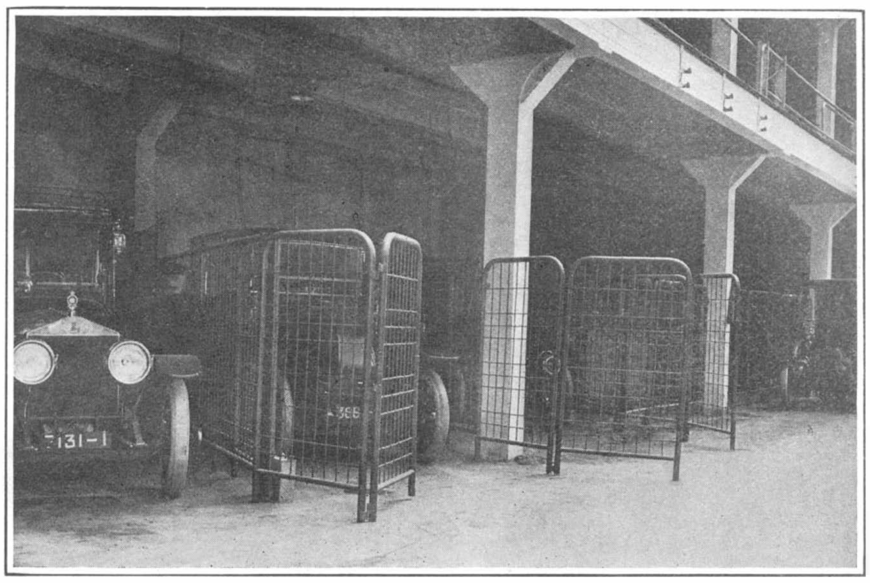
In recent years the question of trade-mark rights in China has become one of great importance and of great difficulty, especially in cases where Japanese are involved, because the Japanese code of ethics, whether commercial or diplomatic, does not coincide with that of western nations. In some cases of dispute between American and English manufacturers in regard to infringements of trade-marks a solution of the difficulty has been arrived at by applying certain standards of commercial ethics as understood and appreciated by business men of these nations. The Japanese view, however, appears to be that a trade-mark, no matter how long it has been used and recognized, is not entitled to any respect or protection unless registered in the proper department of government in Japan.

Anomalous as it may seem, the trade-mark laws of America, Great Britain and other nations have been held not to extend, under the theory of extra-territoriality, to China, although all other branches of law applicable to local conditions are constantly enforced by the judicial tribunals of the various nations enjoying treaty rights in China, under the principle or theory of extra-territoriality. Hence, in cases of infringement of trade-marks, redress can be secured only through diplomatic and consular channels or voluntary submission of disputed points to arbitration.

# Some Interesting Automobile Novelties

## Lockers for Automobiles

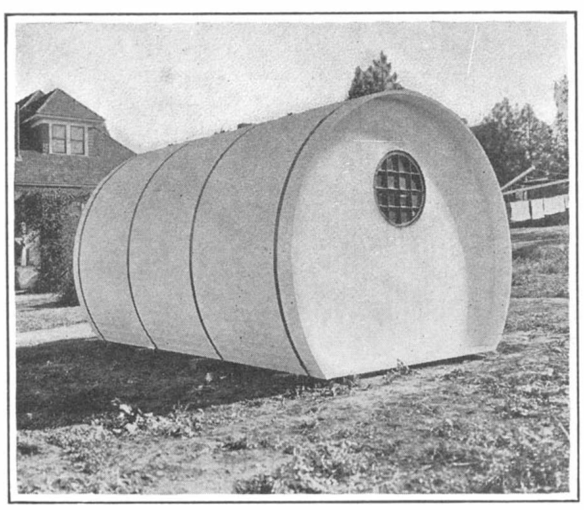
WHAT assurance has a man who leaves his car at a garage that his machine will not be used in his absence? What assurance in this case can the manager of the garage give his patrons? It is an open building, to which all have access, and while there is little danger of the loss of a car it not infrequently happens that chauffeurs or even employees of the garage go out for a joy ride with a car to which they have no right. Now the matter is not liable to be detected unless the car meets with an accident. Another annoyance lies in the borrowing of tools from the tool box of the car that is nearest at hand. Frequently the tools are not returned, and gradually the stock dwindles. In order to provide better security for cars and car accessories the locker system should be employed, as in the accompanying illustration. Closed and locked about each car is a stout iron fence, which will make the car inaccessible for pilfering and render it impossible for any one to take the car out without a key to the barrier fence.



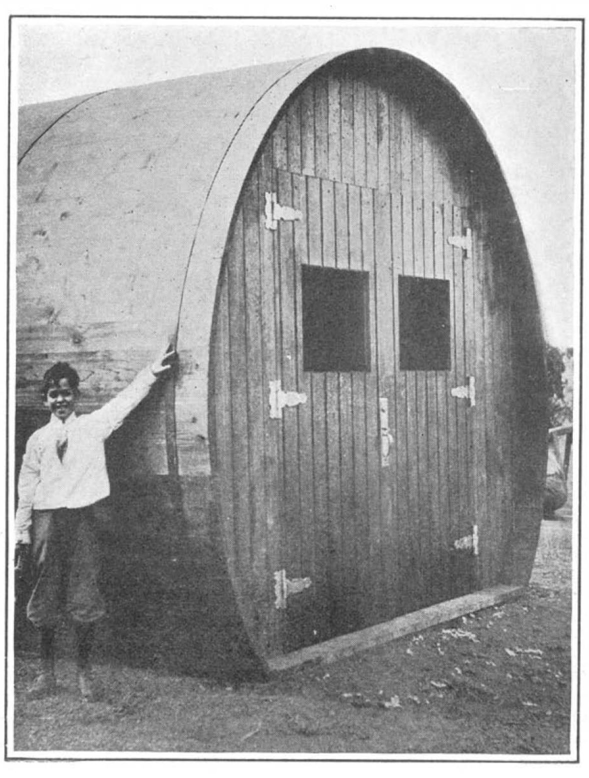
**Locker stalls for automobiles.**

## A Barrel-shaped Garage

THOUGH it resembles a big barrel, this odd structure is in reality a garage and a very good one. It is built of 2-inch boards of 14 foot length, and the width of the structure is 12 feet. Instead of being held together by nails, the building is kept solid by four heavy iron hoops, which are held snug by bolts and nuts at the top. Only an hour is required to set up the building and it can be taken apart for setting up elsewhere in a few minutes. This portable feature makes it valuable for other purposes besides a garage; as a prospector's cabin, summer cottage, or other nonpermanent structure it is ideal. As it is practically airtight, it has a particular value in freezing weather, for the engine of a car that has been operated in the daytime is sufficient to heat the interior and keep it warm all night, or if the car is idle, a very small heating apparatus will keep the garage from undue chill. In fact, the staves and floor and ends, with their tongued and grooved joints make a building almost as tight as a tank. Of course a few coats of paint will make it impervious to rain. This building method is very economical as there is no waste lumber and the cost of assembling is slight; the parts fit together so simply that any unskilled man can set it up in a short time. It is not necessary to set up a permanent foundation, as the building is very light; in fact, it can all be carried, when dismantled, upon a single wagon. In order to simplify the construction, the only openings are at the ends, a double door with windows, and in the rear a circular window. This garage is on the home-place of the inventor in Spokane, Wash., where it has been found satisfactory in every particular.



**This is not a barrel, but a garage.**

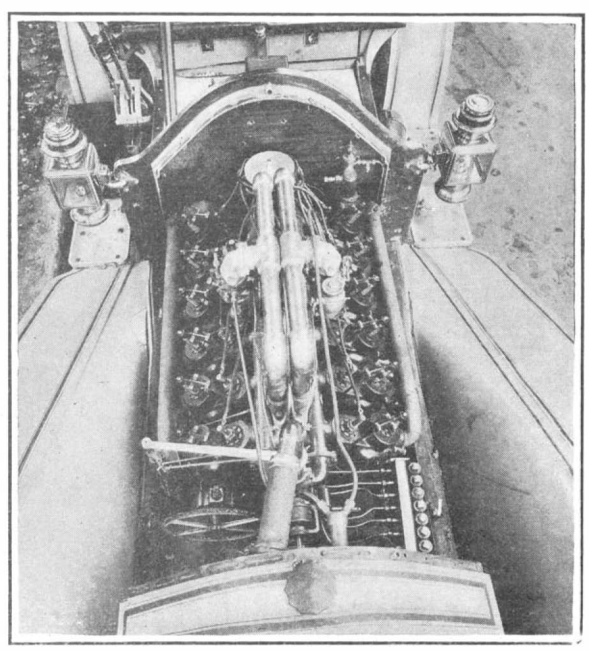


**Entrance to the portable garage.**

## The First American Twelve-cylinder Car

IN a note in the SCIENTIFIC AMERICAN of January 30th last, reference was made to the increasing number of cylinders in automobile engines, with a hint that twelve-cylinder engines might come into vogue. In support of this prediction we drew attention to the twelve-cylinder "Sunbeam" racing car of British make, which holds some records on the Brooklands track. Our statement that one of these cars took part in the Indianapolis Speedway races is corrected by W. G. Wall, chief engineer of the National Motor Vehicle Company, who reminds us that it was not a twelve, but a six-cylinder "Sunbeam" car that entered the races.

Mr. Wall sends us the accompanying photograph of the first American twelve-cylinder automobile engine which was built by Mr. George Schebler of Indianapolis and put in a car in 1910. As will be noted, the engine is of V-type with overhead exhaust valves. In view of the present interest in cars of eight and more cylinders it is notable that this original "twelve" has been running for the last five years and is still in use.



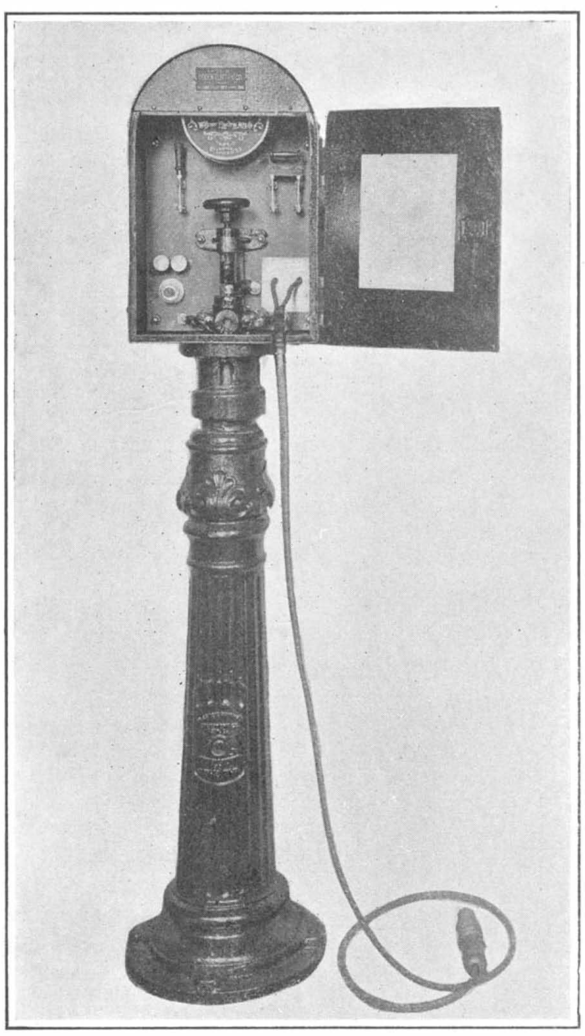
**Twelve-cylinder American car built in 1910.**

## Vehicle Batteries Charged at the Curb

ANOTHER invention has been perfected for the convenience of motor vehicle owners. Electric cars can now have their batteries charged at the curb without entering the garage. The charging outfit is a very compact apparatus capable of supplying any electric pleasure or commercial vehicle with enough current to send it on for five to twenty miles on ten minutes' to one hour's charge.

A slate panel is mounted within an electrically welded steel box only accessible through a steel spring-locked door. The box contains ammeter, pilot lamp, rheostat, fuses and one main line switch. Connections to supply the service are made through underground cable. A terminal block is provided, accessible through pedestal hand hole. The charging cable folds within the box when not in use. When in use the door of the box can be locked with the cable outside.

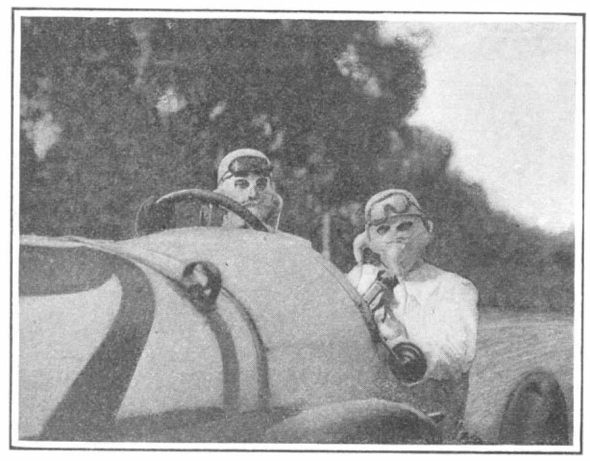
To obtain current application is made to garage attendant, who unlocks the charging station. Charges made depend of course upon how much current is taken. The curb station is intended mainly as a "boost" for the machine until it can reach its destination. A Cincinnati man is the inventor.



**Sidewalk charging outfit for electric vehicle batteries.**

## Speaking Tubes for Racing Cars

ON account of the terrific speed at which automobile racers travel it is practically impossible for the driver and mechanician to speak to each other without slowing down. To overcome this difficulty the device shown in the accompanying photograph was introduced at the Corona race, held near Los Angeles, Cal., on Thanksgiving Day. It was invented especially for the event by Eddie Rickenbacher, and was used by himself and mechanician. It consists of two speaking tubes—one extending from the mouth of each person to one ear of the other—and is combined with the usual head-guard and face mask.



**Speaking tubes on a racing car.**

## Arc-light Controller for Motion Picture Projection Apparatus

THE widespread interest that attaches to motion pictures and the constant advances made in apparatus for their projection is a subject of universal concern. The elimination of the disturbing flickering has largely been accomplished, and now there has been perfected a device for controlling the arc lamp so that the source of light is maintained not only constant as regards its position, but also constant in its intensity. This is accomplished in an invention made by H. N. Baker and originally patented in 1909, but since that time developed and put on so practical and efficient a basis that it has found application in moving picture apparatus of the highest grade, and also for arc projectors used in photo-engraving and searchlights.

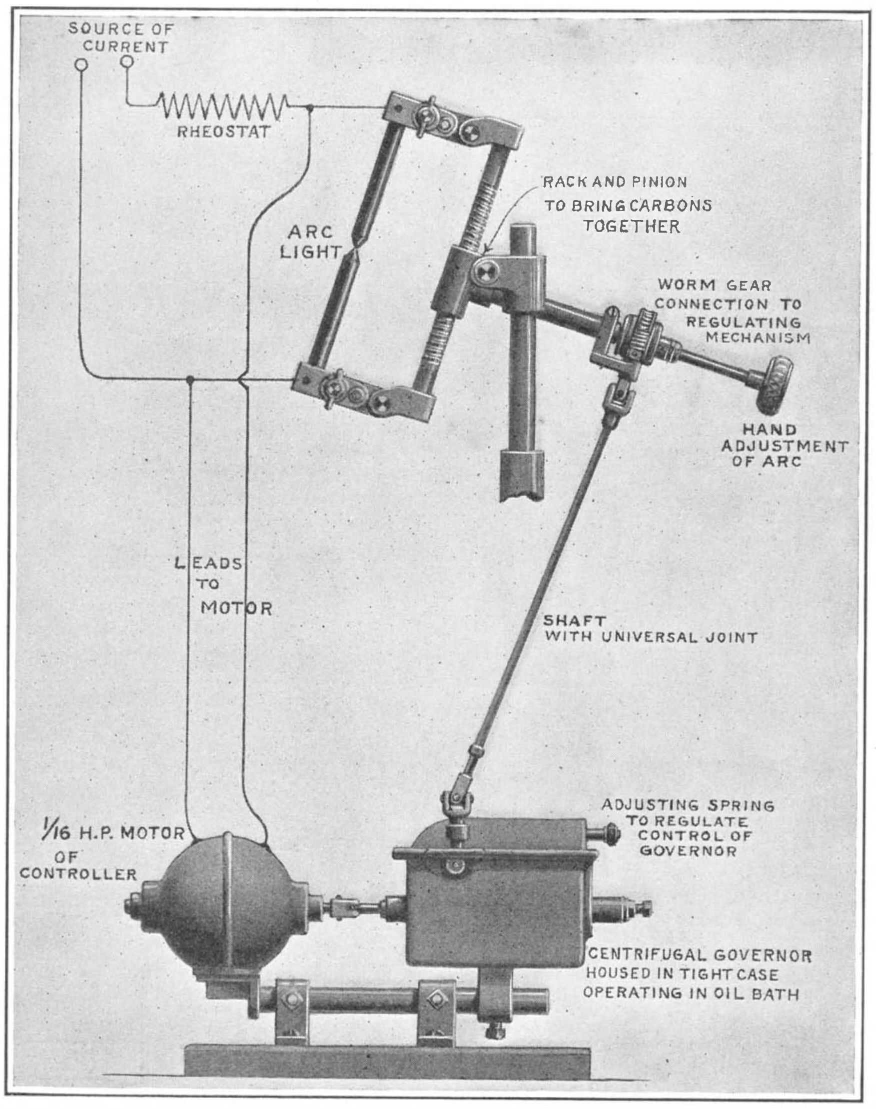
Previously with the hand feed by which the carbons in an arc-lamp were brought together and maintained at the proper distance so as to produce an effective arc, it was not possible to preserve uniformity in illumination, and, as the distance between the carbons varied, there was a corresponding variation in the intensity of the arc as well as a general diffusion of light. Even with a watchful operator, constantly adjusting and feeding the carbons properly, the results were far from satisfactory, while automatic apparatus, in which by some magnetic or other system the carbons were fed mechanically, failed to give the desired results, and even when such mechanism was new there were sufficient variations to interfere with the effectiveness of the projection.

The new device is available for practically any form of hand-fed lamp, and maintains the arc constant so that there is practically no variation in voltage across the terminals. This is secured by means of a motor-driven controller, where a 1/16 horse-power electric motor is connected directly across the arc and is so wound that it will respond to a wide range of potential. The main axis of the armature carries a centrifugal switch, so that when a certain speed is exceeded the weights moving out from the center throw into operation a system of gearing, which connects with the lamp mechanism and moves the carbons together. The speed of the motor depends upon the voltage across the arc and this naturally depends upon the separation of the carbons. If the carbons are separated widely the voltage naturally is greater and more current passing through the motor increases the speed of revolution. This affects the centrifugal governing device and communicates the motion, suitably reduced, to the regulating mechanism. This brings the carbons together until the normal voltage is restored, when the speed of the motor falls and the centrifugal mechanism ceases to operate.

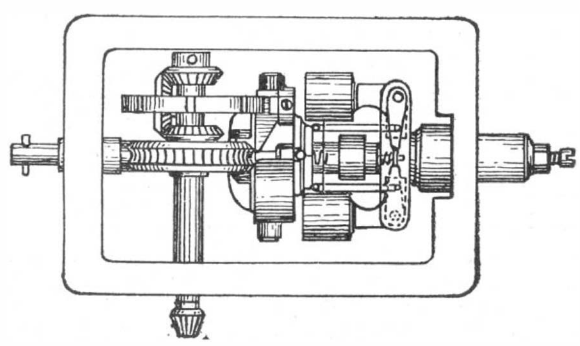
Instead of a variation from two to six volts ordinarily encountered, the potential difference across the arc can be held to less than one tenth volt and the arc maintained for several hours absolutely constant and in the position set at the first adjustment. The shaft connecting the centrifugal governor with the regulating mechanism is telescopic and mounted on universal bearings at either end, so that the lantern may be shifted from ordinary projection apparatus to that for moving pictures, and the whole control system is regularly connected and housed so that it gives very little trouble and can run for hours without adjustment or attention. Not only is the arc maintained constant, but uneven and unnecessary wear of carbons is prevented and stopping for renewal or adjustment of carbons during the course of a performance is obviated. By means of an adjustable spring against which the centrifugal governor acts, regulation can be effected to any desired voltage or length of arc, and the control will act surely and automatically.

As used with the projection apparatus of several of the large motion picture companies, the new speed controller has served to decrease the flickering and variations in intensity of illumination to a marked degree, and as a result of experimental installation other machines are being equipped with this device. It has also been used to control the arc of a large projection lantern in the photo-engraving laboratory of a bank-note company, where an arc is maintained between carbons 1¼ inch in diameter for the upper carbon and 1 inch in diameter for the lower. The speed controller also has been applied to searchlights, so that it is possible to maintain constant the beam of light emitted and regulate its direction by operating gear from some distant point, such as a bridge or observation platform, without the presence of an operator at the searchlight itself.

The motor of the arc controller is so small that the consumption of current is inconsequential, and the increased economy at the arc itself more than compensates for the small amount shunted through the motor. The latter is so wound that it will respond to any amount of current at the arc, whether it be five or more than one hundred amperes. The important additional consideration is the fact that the attention of the operator is released from the lamp and he can devote himself entirely to the control of the films, and thus secure the best results. The entire mechanism has been so well arranged and developed that it promises to have a striking effect upon motion picture projection, and especially where high power lamps are produced. The accompanying diagrams indicate in a general way the operation of the apparatus and the construction of the centrifugal governor.




**Apparatus for eliminating the flicker of arc lights.**



Centrifugal governor.

**The gearing of the governor.**

## Welding Water and Gas Mains

THE gas welding processes which have come into vogue during recent years, particularly the oxy-acetylene and the oxy-hydrogen procedures, have been extending themselves into fields of activity far removed from the machine shop and foundry. Among these new applications is that of steel pipe laying. Already mains have been laid by gas welding in the cities of San Francisco, Chicago, and Peru, Ind. In fact, at San Francisco, in addition to a high pressure gas main in the city proper, the entire system of gas and water mains for the Panama-Pacific Exposition has been gas welded.

One of the great advantages seems to be the reasonable prospect of a long life for the joint—of a life as long as that of the pipe line itself. Apparently, gas mains in the past have had to be abandoned when only partially worn out because of deterioration of the joints. The new procedure does not employ any other metal markedly different from the pipe itself at the joints, and a steel pipe line is welded up with a material that is approximately steel. When the pipe is once laid, the whole affair—joints and all—becomes in effect a single piece of steel. It is possible that electrolytic action will be almost eliminated, as such action only takes place where there is a difference in metals. The strength of the joints will be a very considerable percentage of the strength of the pipe. Indeed, it is in general possible, wherever it seems de-

(*Concluded on page 277.*)

**Welding water and gas mains.**

## RECENTLY PATENTED INVENTIONS

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

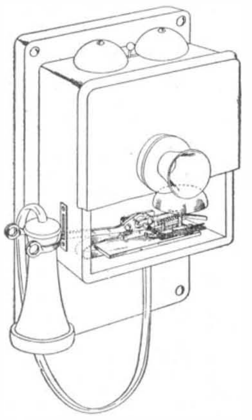
### Pertaining to Apparel.

FINGER RING.—J. SCHMIDT, 629 9th Ave., Manhattan, N. Y., N. Y. An object in this invention is to provide a finger ring with an improved form of seat of the Belcher style, and a setting secured to the seat, whereby the body of the ring may be of one metal and the setting of another, or of the same metal.

### Electrical Devices.

ELECTRIC SIGN.—A. J. BROWN, 4507 Calumet Ave., Chicago, Ill. This invention relates to advertising devices, and more particularly to an illuminating display sign. It provides a sign constructed so that the advertising matter will be clearly discernible in the daytime and in the nighttime by means of a source of light.

PARTY LINE LISTENING-IN-DETECTING DEVICE.—C. A. KRAMER, care of New Wellington Apt's., N. Monroe St., Spokane, Wash. This invention relates more particularly to an indicating or detecting device for each subscriber's set, whereby it is possible to detect any party listening in to a conversation. The



PARTY LINE LISTENING-IN-DETECTING DEVICE.

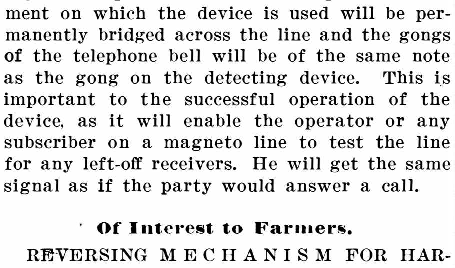
regular telephone bell of the telephone instrument on which the device is used will be permanently bridged across the line and the gongs of the telephone bell will be of the same note as the gong on the detecting device. This is important to the successful operation of the device, as it will enable the operator or any subscriber on a magneto line to test the line for any left-off receivers. He will get the same signal as if the party would answer a call.

### Of Interest to Farmers.

REVERSING MECHANISM FOR HARVESTING MACHINES.—H. QUEGWER, Bunzlau, Silesia, Prussia, Germany. The advantage of this device consists in the fact that by the application of a comparatively small amount of force applied near the seat the mowing or harvesting machine can be run backward from the driver's seat and in the automatic release effected before the machine commences its forward motion, thus preventing the parts from being broken.

MILK STERILIZING APPARATUS.—J. MÉRIE, 135 Rue d'Alésia, Paris, France. The device comprises a sterilizer in combination with a pump and a closed tank or compressor. The pump is adapted to feed the sterilizer; the compressor-tank serves for the regulation of the pressure. The sterilizing apparatus is formed by the combination of two known elements, but constructed in such a way that their conduits and the piping which connect them is of equivalent cross-section, that is to say, constant throughout the path of the milk.

DAM APPARATUS FOR IRRIGATION DITCHES.—F. E. MENDENHALL and W. G. ERSKINE, Minatare, Neb. The invention relates more particularly to that class wherein a dam curtain is maintained in a stretched condition across and forming a stop for a ditch, combined with a time-controlled mechanism for releasing the dam curtain. An arrange-



DAM APPARATUS FOR IRRIGATION DITCHES.

ment of beams sufficiently supports a dam curtain and releases the same at a predetermined time, the confronting faces of the beam being provided with a series of complementary triangular ridges and depressions adapted to rigidly grip the curtain without likelihood of mutilating or tearing the same, even after repeated use.

BALE TIE.—I. M. THOMPSON, Bear Beauregard Parish, La. A purpose here is to provide a structure which when placed in position will become locked to the bale. Another is to provide a tie with a spur having a hooked portion which when driven into place will interlock with the remaining parts so that the spur cannot work loose.

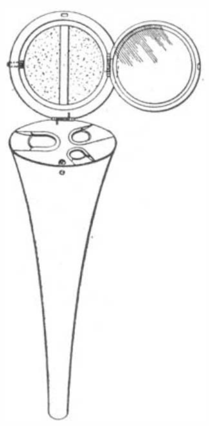
### Of General Interest.

METHOD OF COLORED PHOTOGRAPHIC REPRODUCTION.—J. LEWISOHN, 88 Fifth Ave., Manhattan, N. Y., N. Y. The process can be used with only two, or with more than three colors, if desired. The principle consists in forming on a blue print a series of superposing blue images, of which the preceding blue color of the image has been substituted by another color before the succeeding blue image has been formed.

JETTY CONSTRUCTION.—R. D. A. PARROTT, 114 E. 28th St., New York, N. Y. The purpose here is to provide a jetty construction designed for building jetties, bulkheads, groins, breakwaters, dikes, levees and the like, either on the seashore or along rivers, to prevent erosion and to aid in the deposit of sand or other similar fine material.

SOCKET ATTACHMENT FOR HARNESS.—A. H. WESTERMAN, 402 South Broadway, Brownwood, Tex. The improvement has reference to harness construction, and more particularly to a device whereby one strap of a harness is slidably connected with another strap, the device serving to reinforce that strap through which the slidable strap extends.

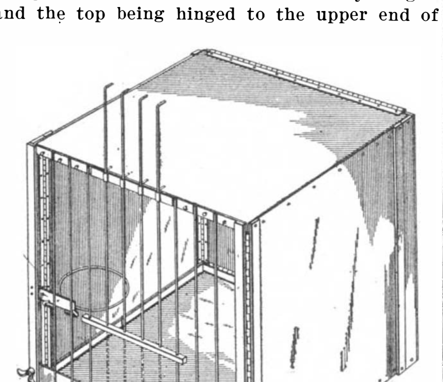
COMBINATION PARASOL HANDLE.—D. REICH, 1823 Prospect Place, Brooklyn, N. Y., N. Y. The handle forms a vanity case and is so fitted as to contain a mirror, a powder puff, and a coin case. These accessories are arranged inside the handle of a parasol, umbrella or the like, so as to save women a great deal of unnecessary inconvenience by having the



COMBINATION PARASOL HANDLE.

several articles combined in one, thus permitting the user to have one hand entirely free, while the other is used for holding the parasol or transporting the same, especially in hot weather, while at the same time permitting her to conveniently use the accessories of the vanity case as well as to have the powder puff, mirror, and money all safely stored away in the handle.

KNOCKDOWN COOP OR CRATE.—A. J. THUNEMANN, 751 Kentner St., Defiance, Ohio. This coop or crate is more especially designed as an expedition or transportation coop for chickens and other animals, but also serviceable as a crate for storing and shipping merchandise and the like. Use is made of a front, a back, sides, a top and a bottom, the front being connected one with the other by hinges, and the top being hinged to the upper end of

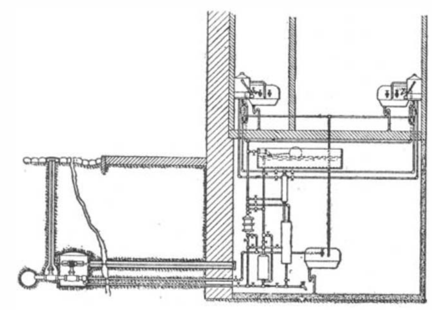


KNOCKDOWN COOP OR CRATE.

the back to fold upon one face thereof, and the bottom being hinged to the lower end of the back to fold upon the other face of the back. Use is also made of an openwork front having a rigid frame, sets of spaced bars attached to the top and bottom members of the frame, the sets being spaced apart to form an entrance to the coop.

AUTOMATIC DAM.—W. L. MARSHALL, care of Reclamation Service, 8th and E Sts., N.W., Washington, D. C. An object here is to provide a siphon which co-operates with the operating conduits and valves in such a manner that the dam or crest will be made to fall down when a predetermined fluid height or water level is attained and again raised when the fluid shall have subsided to a predetermined and fixed lower level.

WATER SYSTEM.—GERTRUDE M. KREMELBERG, Pittsfield, Mass. The primary object of this invention is to devise a system wherein means are provided for sterilizing and filtering the entire system when found necessary. It is well known that typhoid fever frequently breaks out among those returning in the fall from favorable country districts to their city homes. The trouble is most likely to come from the service pipe between the house and



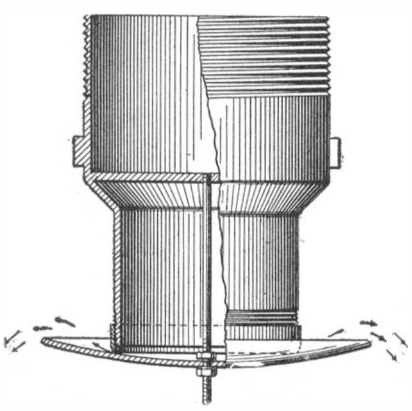
WATER SYSTEM.

the city main. A pipe which is left to dry out absorbs gases and perhaps germinates in the hot season when germ life is ripe and the pipe is open and unused. All the dangerous residue is washed into the city home when the water is turned in. The Kremelberg system prevents these menaces and disadvantages by thoroughly flushing out all traps, boiling out all pipes, and completely airing the house before the return of the household from various winter and summer resorts.

BARREL HOOP.—H. LLOYD, 449 W. 2nd St., Lexington, Ky. In this instance means are provided for permitting the circumference of the hoops to be varied, within wide limits, but with small successive increments, or decrements, without impairing the strength of the hoop, and with a comparatively small number of openings in the hoop strip.

PROCESS OF TREATING INGOTS.—H. W. HIXON, The Covington, Chestnut and 37th Sts., Philadelphia, Pa. Mr. Hixon's improvement has reference to the process of treating ingots, his more particular purpose being to produce ingots so as to avoid the formation of blow holes and pipe and to render the metal dense, smooth, and readily adapted for rolling.

LEACH SPRAYER.—B. F. AMISS, 27 Lake St., Salem, Va. This invention relates to improvements in spraying devices, and particularly to those for spraying leaching fluids, and it provides a structure which will spray the fluid over a comparatively large area, and



LEACH SPRAYER.

which will not become clogged or stopped. The device sprays the fluid through the use of an inverted plate and an adjustable ring co-acting therewith, whereby the fluid may be distributed over a considerable area and in any desired bulk.

LIFE SAVING APPARATUS.—A. N. McGRAY, 119 W. 71st St., New York, N. Y. The invention relates to a net or an inclined way for use in connection with ships, especially large ones, whereby easy and safe disembarking of passengers and crew from a ship in distress to life boats can be effected, especially during the running of a heavy sea, and whereby passengers can with ease and safety board a rescuing ship from life boats.

STATIONARY MORTAR SPREADER.—F. H. NEUBERGER, East Branch, N. Y. This invention pertains to improvements in mortar spreading devices, and has for an object to provide an improved structure in which mortar is adapted to be quickly and easily applied to concrete blocks and the like without wasting any of the mortar.

PHOTOGRAPHIC CAMERA.—J. A. DE BOUZEK, 4th South and Church Sts., Salt Lake City, Utah. This invention provides a camera adapted to receive a plurality of exposures on a single sensitized plate, in predetermined locations; provides means for adjusting said plate with reference to the arrangement designed for the photographs; and provides means for adjusting the ground glass to any position in a camera and to bring the image quickly to any location without moving the subject or the camera.

### Hardware and Tools.

LOCK FOR MAIL BOXES.—C. F. UTTERBACK, Lock Box 201, Mooresville, Ind. The particular purpose here is to provide a device having improved mechanism for safe-guarding mail placed in the box, either by the owner of the box or by the postman, and having special provision for enabling the operator to save time, under proper conditions, otherwise wasted in locking and unlocking the box.

SYRINGE.—F. S. DICKINSON, care of Becton, Dickinson & Co., Rutherford, N. J. In this device use is made of a combined finger piece and plunger retainer, of which the finger piece is held on the barrel and the plunger retainer is in the form of a coil spring attached at its ends to the finger piece and engaging the outer surface of the plunger so as to hold the latter against accidental dropping out of the barrel.

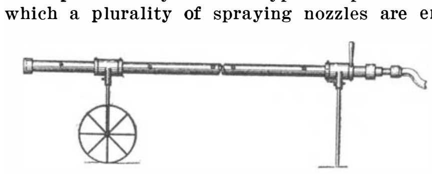
WRENCH.—J. EHRHARD, Curtis, Okla. This wrench is of comparatively simple construction and admits of a great variety of uses. The invention relates to means for rendering the wrench adjustable quickly and yet accurately. It contemplates various other advantageous features, for the purpose of improving the general efficiency of the wrench.

MECHANICALLY OPERATED SCISSORS.—W. I. JONES, Watkins, N. Y. The object here is to provide a pair of scissors with a casing to which one of the scissor blades is secured, the other blade being pivoted to the casing and the first blade and being provided with a slotted arm in which is disposed a pin on a disk journaled for rotating in the casing, so that with the rotation of the disk the scissors will be operated.

SHEARS.—W. I. JONES, Watkins, N. Y. The two blades are articulated together, both upper and lower having extensions from the cutting edges of the blades. The extension on the upper blade, which is called a guard, extends upwardly and forwardly relatively to the cutting edge of the said blade, and the extension on the lower blade tapers outwardly from the lower blade and is provided with an enlarged rounded forward terminal.

SASH BALANCE AND LOCK.—G. R. KELTNER, care of C. E. Miller, P. O. Box 1026, Phoenix, Ariz. The object here is to provide a combined sash balance and lock simple in construction, durable in use, and readily and easily operated. Means provide for balancing the sashes in all positions of adjustment and for immediately relocking the sash through the action of a spring which returns the parts to the positions desired.

PORTABLE LAWN AND GARDEN SPRINKLER.—G. J. NIKOLA, 187 Vanderbilt Ave., Brooklyn, N. Y., N. Y. The invention relates more particularly to that type of sprinkler in which a plurality of spraying nozzles are em-



PORTABLE LAWN AND GARDEN SPRINKLER.

ployed, whereby a large area can be sprayed at one time, the water being discharged from the apparatus in the form of a fine mist, so that the ground and vegetation will be moistened in a manner closely approximating nature.

### Heating and Lighting.

FLASH LIGHT.—W. S. MCGUIRE, Shadyside, Ohio. This invention provides an automatic contrivance whereby the intensity of the light produced by the flash can be modified by reflectors and screens. It also provides a flash light for use in photography which has a source of light for indicating the light effect that the flash will produce when set off.

SIDEWALK SKYLIGHT.—H. DE CORDOVA L-No. 34 (Bajos) Vedado, Habana, Cuba. Among the objects of the invention is to provide a sidewalk skylight construction which is adapted to provide not only light but ventilation, but without subjecting the basement or subway to the unsanitary conditions usually accompanying ventilating devices heretofore proposed.

ARTIFICIAL FUEL AND METHOD OF MAKING THE SAME.—E. J. BABCOCK, College of Mining Engineering, Grand Forks, N. D. The invention relates to methods of treating lignite coal, and more particularly is directed to the manufacture of fuel briquets from lignite or other non-coking coal, the principal object being to utilize a low grade, non-coking coal, such as lignite, in the manufacture of a high grade, valuable, and artificial fuel.

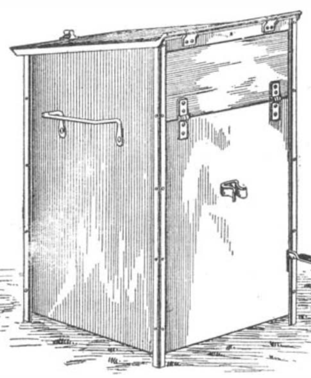
### Household Utilities.

FOLDING CHAIR.—C. L. CRAIG, Washington Court House, Ohio. A movement of the seat causes the rear supporting legs to open or close, according to the direction of movement of the seat. Means provide for holding the seat in its unfolded or open position, and at the same time exert the proper pressure upon the rear legs to hold the same in their opened position, thereby preventing any possibility of collapse. The principle can be applied to swings, couches, and similar folding articles.

STOVE.—G. T. OGLESBY, Frankfort, Ind. This invention relates to stoves suitable for heating dwellings and stores, the more particular purpose being to produce a stove adapted for great economy in the use of fuel, and so constructed that, if made of small size, it does a comparatively large amount of heating.

GARBAGE CAN.—E. FRANCKAERTS, 396 Waller St., San Francisco, Cal. An object here is to provide an extremely sanitary garbage

can which can be easily filled and emptied. Also to provide a can having a foot operable chute which may be opened to allow filling of



GARBAGE CAN.

the can, the mechanism for operating the chute being inclosed in a removable housing where it is protected from the elements and the contents of the can, and where it may be uncovered by removal of the housing when it is desired to repair the mechanism.

WINDOW WICKET OPERATING MECHANISM.—H. B. GABBE, 979 E. 163rd St., New York, N. Y. The invention provides a locking mechanism to maintain the wicket in closed position; provides a readily-operated mechanism for moving the wicket to open or closed position; provides a means for maintaining the wicket in adjusted position; and provides means for locking the wicket in a number of positions.

EXTENSIBLE WINDOW SCREEN.—R. T. BISHOP, Woodhaven, L. I., N. Y. The purpose here is to make screens more attractive in appearance, easier to adjust, and so designed as to be devoid of gaps through which flies, mosquitos, or other insects may enter, as the netting is of one piece with an end rigidly fastened to one section of the screen, and the other end being fastened on a roller mounted in the other section of the screen, whereby the netting is wound or unwound as the screen is contracted or extended.

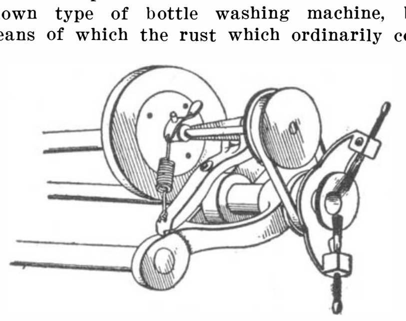
CLOTHES LINE SUPPORT.—J. T. PILKINGTON, R. D. No. 4, Armstrong, B. C., Canada. The invention relates to means for supporting a pulley line, and particularly to supporting means adapted to be affixed to the side of a house and to a post, or to two posts or other equivalent uprights. Free space is provided at all sides of the pulleys so that an endless clothes line, with clothes hung thereon, may freely pass, with the clothes, around both pulleys.

### Machines and Mechanical Devices.

CLUTCH.—A. BONOM, Central Building, Paterson, N. J. The invention relates more particularly to a clutch whereby the transmission from one shaft to another is first obtained by a frictional engagement of means carried by the shafts, and then by bringing in engagement means adapted to transmit positively the motion of one shaft to the other, and thus not depend on the frictional engagement of the parts.

SPINDLE TESTER.—P. REILLY, 15 Green St., Worcester, Mass. The object in this case is to provide a tester arranged to permit an operator to quickly and accurately ascertain the efficiency or non-efficiency of the spinning and twister spindles without requiring stopping of the machine or removal of the spools or bobbins from the spindles.

ATTACHMENT FOR BOTTLE WASHING MACHINES.—S. MARTINELLI, JR., 229 3rd St., Watsonville, Cal. The invention relates more particularly to an attachment for a bottle washing machine, and one of the principal objects is to provide an attachment for a well-known type of bottle washing machine, by means of which the rust which ordinarily col-



ATTACHMENT FOR BOTTLE WASHING MACHINES.

lects at and adjacent to the crown groove of a bottle neck may be removed, simultaneously with the cleansing of the interior of the bottle. Another object is to provide an attachment including rotary brushes, means for adjusting them, means for attaching them to the machine, and means for driving the brushes from the spindle of the machine.

MACHINE FOR CUTTING AND PASTING STAMPS TO CIGARETTE BOXES OR ANY OTHER PACKAGES.—JOSÉ IBARRA, Habana, Cuba. This invention provides means for automatically delivering in separated condition boxes into the path of stamps for enfolding said boxes, and means operating in correspondence with the box delivery for severing and delivering said stamps to an operating station, to be mechanically wrapped about, and caused to adhere to, each of the boxes at said station; provides a machine wherein the above means are multiplied and united to be operated by a common driving mechanism; and provides means for delivering the boxes after having the stamps applied thereto.

PROPELLER.—C. T. A. H. WIEDLING, 124 26th St., Guttenberg, N. J. The invention pertains to rotary propellers for ships, balloons, flying machines and similar vehicles, and it is also of equal usefulness for other devices and machines, as a rotor for steam, water or other fluid turbines, pumps, air compressors, blowers, fans, etc. The object is to reduce vibrations.

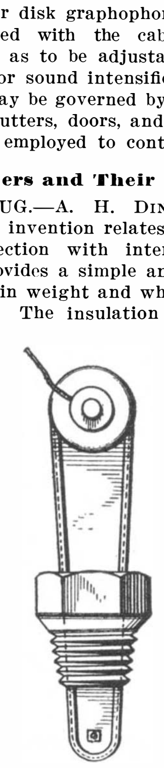
KEYING DEVICE FOR ROLLS.—W. F. KIRK, care of McLanahan Stone Machine Co., Hollidaysburg, Pa. This speedy and powerful mechanism is especially designed for crushing limestone, and has but one roll, co-operating with a fixed plate, and by means of which the stone may be crushed to varying degrees of fineness in accordance with the adjustment.

### Musical Instruments.

GRAPHOPHONE CABINET.—L. F. CLAWSON, JR., 5 North Nashville Ave., Ventnor, N. J. The cabinet for disk graphophones comprises a lid so combined with the cabinet body and other elements as to be adjustable to form, in effect, a horn or sound intensifier in which the tone volume may be governed by the lid to take the place of shutters, doors, and the like, which frequently are employed to control the volume.

### Prime Movers and Their Accessories.

SPARK PLUG.—A. H. DINGMAN, Allison Park, Pa. The invention relates to spark plugs used in connection with internal-combustion engines. It provides a simple and efficient plug which is light in weight and which is moisture and oil proof. The insulation protecting the



SPARK PLUG.

electrode is so inclosed as not to be affected by moisture of the atmosphere nor by the gases of the cylinder, as certain openings receive enamel which prevents the gases entering the casing or oil working therebetween. The structure, therefore, insures permanency to the spark-plug.

STAY BOLT FOR BOILERS.—H. A. LACERDA, 303 Campbell Ave., Schenectady, N. Y. The invention provides a stay bolt for the fire boxes of boilers and like structures and arranged to prevent leakage, to allow expansion and contraction of the bolt without unduly straining the boiler sheets, and to permit movement of the sheets in the direction of their plane without causing shearing or similar injuries to the stay bolt.

GAS ENGINE SPEED CONTROLLER.—R. S. ANDERSON, care J. Wade Anderson, Laurens, S. C. This invention relates to internal combustion engines, and more particularly to regulators therefor. It improves and simplies the construction and operation of regulators referred to so as to be reliable and efficient in use, and easily and quickly manipulated for heavy, no load, and intermediate load conditions with a maximum economy of fuel.

CARBURETER.—L. M. FRANCISCO, Baldwinsville, N. Y. The invention is more particularly designed to provide satisfactory starting and operation with kerosene as a fuel. Among its objects are: to provide means associated with the nozzle, to heat the latter, and thereby heat the fuel in the passage from the float chamber to the nozzle, as well as to furnish heat for the float chamber itself; and to provide in connection with the air intake a means for utilizing the heat from the exhaust pipe to heat the air in an effective manner.

DISK VALVE FOR INTERNAL COMBUSTION ENGINES.—J. S. O'NEAL, care of Munro Hotel, Cincinnati, Ohio. The improvement provides a valve controlling the inlets or outlets of a pair of cylinders of an internal combustion engine and so positioned that the thrust on the valve produced during the explosion or the compression in the cylinder is reduced to a minimum, and also the leakage of gas between the valve and its seat.

### Railways and Their Accessories.

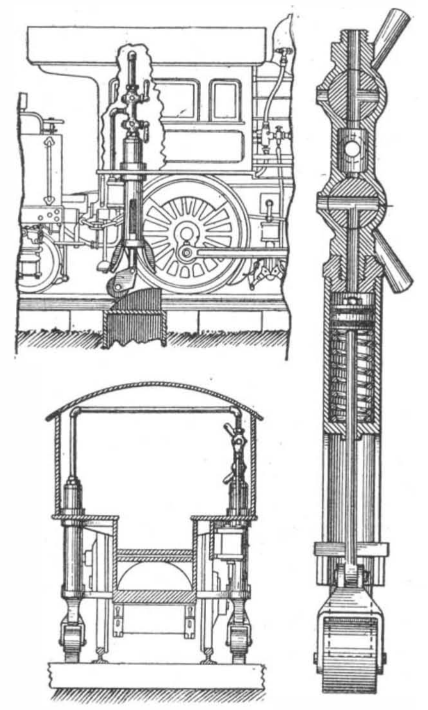
ROADSIDE DEVICE FOR AUTOMATIC TRAIN STOPS.—M. C. WRIGHT, 569 West End Ave., New York, N. Y. The invention has particular reference to devices arranged along the railway track or roadbed, and associated with either the switch, signal, or other means for automatically controlling the position of an obstacle adapted to be struck by a locomotive or train device, to prevent an accident should the train for an reason pass a danger signal, or other points, at or before which it should be stopped.

RAILWAY TIE.—S. H. HERBST, JR., Fullerton, Pa. One of the main objects here is to provide a tie which insures a resilient seat for rails, which permits the removal of said seats without disturbing the tie itself, which is formed primarily of metal and concrete, which presents an enlarged area of tie supporting surface at its under side in the position of each rail, and which provides metal reinforcing plates for the resilient means in order to prevent injury thereto.

DEVICE FOR REMOVING SNOW, ICE, AND SLEET FROM CHANNELS AND CHANNEL RAILS OF UNDERGROUND RAILWAYS.—F. J. KROBOTH, 500 W. 150th St., New York, N. Y. This improvement relates to appliance or apparatus adapted for use in connection with underground railways systems, and the object thereof is to provide means for removing snow, ice, and sleet from the channels and channel rails of said railway systems.

AUTOMATIC TRAIN STOP.—J. H. PRALL, Innes, Saskatchewan, Canada. The invention resides more especially in the track devices, which comprise a trip adapted to be thrown into position to be engaged by an element on the train, the trip being mounted to be thrown into operative or inoperative position, and to yield to a train passing in either direction, while affording sufficient resistance to actuate the train devices, being usually in the form of means to relieve the air pressure in the train pipe of air brake systems.

AUTOMATIC SWITCH.—H. H. PALMER, 64 Columbia St., Charleston, S. C. The invention has reference to means for operating railway switches automatically through the medium of a manually controlled operating device on the



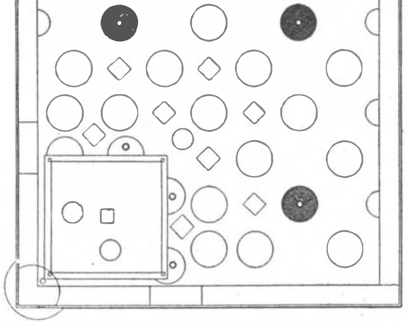
AUTOMATIC RAILWAY SWITCH.

train. In carrying out the invention, use is made of a trip roller adapted to engage plungers arranged in the track, the plungers being arranged to be depressed under the influence of air pressure supplied by the air brake system.

### Pertaining to Recreation.

SPINNING DEVICE.—F. WANKEL, 748 Chatham Square, New York, N. Y. The inventor provides a spinning device for spinning tops, propellers and like articles, and arranged to permit of quickly placing the top or other article in position on the spinning device and to allow of readily actuating the latter with a view to spin the top or to cause the propeller to ascend.

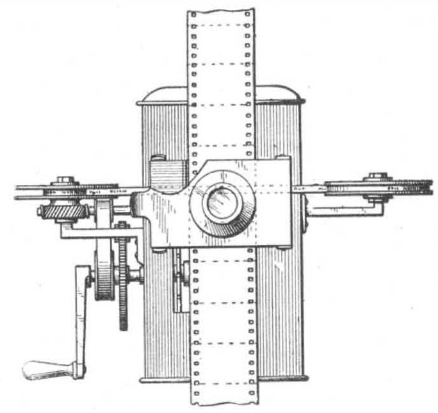
PARLOR BASE BALL GAME.—J. STRAUB, care of Blackstone Hotel, Chicago, Ill. In the present patent the invention has reference to a parlor base ball game whch is played by the delivery of a missile onto a board representing



PARLOR BASE BALL GAME.

a playing field, and in which the various features of the ordinary base ball game are reproduced in a manner well calculated to afford amusement without danger to surrounding articles.

ATTACHMENT FOR MOVING PICTURE MACHINES.—A. H. F. KURRE, 283 5th Ave., Brooklyn, N. Y., N. Y. Motion pictures of the future may be shown with the full plot and description at the same time. By this invention a strip of reading film is shown above the pictures while in motion; thus the story, the conversation, or description will appear above the picture, doing away largely with the necessity



ATTACHMENT FOR MOVING PICTURE MACHINES.

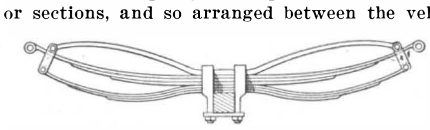
of stopping the picture to show the reading. By means of this invention educational films may be made more valuable because the pictures do not have to be interrupted by reading matter, as both are shown simultaneously. A broad patent has been granted for the U. S. and patents are pending for all the principal foreign countries. A rare opportunity for a capitalist or film producer.

MOVING PICTURE MACHINE.—C. A. STOREY, 1124 J Ave., West, Cedar Rapids, Iowa. This invention provides a structure which will cause a proper movement of the film past or through a beam of light by a simple continuous moving structure which may be run at any desired speed, and which will cause the usual stationary period for the film at the right time.

### Pertaining to Vehicles.

SPRING SUSPENSION DEVICE FOR VEHICLES.—J. A. SHEARER, Glen Osmond Road, Parkside, S. Australia, Australia. The invention relates to the suspension or mounting of the frame of a motor car or other vehicle or traveling machine upon its axles by means of levers connected with the axle and pivoted to the frame and adapted to be moved against the action of a spring or springs when said axle is raised relatively to the frame or chassis so as to absorb the shock or jar caused by the passage over rough roads or over irregularities or obstacles. Mr. Shearer has invented another spring suspension device in which each end of the axle is attached to the pivotally connected adjacent inner ends of two longitudinally horizontal links, the outer end or ends of one or both of which is or are pivotally connected to the frame of the car, vehicle, or machine by a lever and spring device which tends to keep the links as nearly as possible in a straight line and to restore them thereto after displacement.

SPRING.—E. J. STACEY, 131 North Stone Ave., Tucson, Ariz. The invention provides a spring of the multiple leaf type, wherein the leaves of the spring are separated into series or sections, and so arranged between the vehi-



VEHICLE SPRING.

cle and the running gear that the several series or sections of the spring will come into operation in succession, each succeeding series or section supplementing the action of the preceding series or sections.

WAGON END GATE.—C. J. DONAT, Verdigre, Neb. The invention relates more particularly to gates of the type in which the gate is formed of hinged sections, so as to break joint for the convenient placing and removal of the end gate. Means provide for facilitating the manipulation of the gate and its appurtenances, and whereby to hold the gate rigidly when placed in position.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

## NEW BOOKS, ETC.

THE DETERMINATION OF SEX. By L. Doncaster. Cambridge and New York: G. P. Putnam's Sons, 1914.

While the study of sex has not yet reached a stage at which it is possible to give an account of established facts and of generally accepted inferences from them, which shall be free from controversial matter, nevertheless the subject is one which may well be treated in a popular book of this character. The book, however, is more than a completely impersonal survey of the facts; for the author suggests interpretations, which appear to him probable, as well as criticisms of others. The discussion is limited to the problems of sex determination in animals, no reference being made to the work of the same kind which has been done on plants. The book may be heartily recommended as an interesting and instructive treatise.

EVOLUTION OF SEX IN PLANTS. By John Merle Caulter, Head of the Department of Botany, University of Chicago. University of Chicago Press, 1915.

This book may be considered, so far as the average reader is concerned, as a supplementary volume to that of Dr. Doncaster, for sex in animals is not discussed in this book, and sex in plants is not discussed in Dr. Doncaster's book. Prof. Caulter's reputation is a sufficient guarantee that he has produced a trustworthy book. He discusses the subject from the standpoint of a sexual reproduction, origin of sex, differentiation of sex, the evolution of sex organs, alternation of generations, differentiation of sexual individuals, parthenogenesis and a theory of sex.

DIE ROMANTIK DER CHEMIE. Von Dr. Oskar Nagel, Stuttgart: Kosmos Gesellschaft der Naturfreunde, 1914.

Despite its title this book is not a very romantic discussion of the more important aspects of modern industrial chemistry. Still it serves the useful purpose of presenting in easily comprehended German the essential facts of some very important industries based upon chemical processes.

TASCHENBUCH DER LUFTFLOTTEN. Zweiter Jahrgang 1915: Kriegsausgabe. Herausgegeben von F. Rasch und W. Hormel. J. S. Lehmann's Verlag in München.

The war has had its effect upon the publication of the second volume of this most excellent annual. For military reasons it has been deemed expedient by the editors to omit details of the aerial strength of Germany, Austria, and Turkey. The pictures of airships and aeroplanes of these powers which do appear have been published before the war elsewhere. On the other hand, the book gives a very complete survey of the aerial strength of the other powers, and for that reason is most valuable. Indeed, we have found it in actual use in every way most trustworthy.

DISCOVERIES AND INVENTIONS OF THE TWENTIETH CENTURY. By Edward Cressy. New York: E. P. Dutton & Co., 1915.

This book deals with the characteristic features of development in certain selected fields of enterprise during the last 25 years. The subjects discussed are the revival of water-power; coal, gas and petroleum; steam power; gas, gasoline and oil engines; generation and transmission of electricity; electric lighting and heating; speed and economy in factory and workshop; foundry and forge; the electric furnace and its applications; the artificial production of cold and its applications; soil and crops; railways; electric traction; motorcars; modern ships; the conquest of the air; wireless telegraphy; ships of war and their weapons; some applications of photography; radium, electricity and matter. Taken as a whole the book must be regarded as a readable and instructive review of technical progress during the period which it covers.

A SCHOOL ELECTRICITY. By C. J. L. Wagstaff, M.A. New York: G. P. Putnam's Sons, 1914. 8vo.; 250 pp.; illustrated.

The practical nature of this text at once appeals to the instructor. Every experiment it offers has been actually performed by students in the laboratory or the class-room. This, of course, precludes such subjects as X-rays, telephony, and electric waves. Naturally, a fair equipment of laboratory and lecture apparatus is essential. It is suggested that demonstration by the instructor should largely constitute the earlier lessons, after which the experiments may be repeated by the students. In presenting these experiments the author endeavors to strike the happy mean between insufficient detail and over-elaboration. The examples are very largely original, and a few involve the use of the calculus.

PROBLEMS OF AMERICAN GEOLOGY. By William North Rice, Frank D. Adams, Arthur P. Coleman, Charles D. Walcott, Waldemar Lindgren, Frederick L. Ransome, and William Diller Matthew. New Haven: Yale University Press, 1915. 8vo.; 505 pp.; illustrated. Price, $4 net.

"Problems of American Geology" is a series of lectures commemorative of the life and work of James Dwight Dana, "incontestably"—such is the verdict of Von Zittel—"the first geologist of North America." Inspired by his labors, these lectures briefly present his geology, and proceed to a consideration of American conditions and the questions that arise from them. There are the problems of the Canadian shield, the archæozoic and the proterozoic; there is the Cambrian and its problems in the Cordilleran region; the igneous geology of the Cordilleras also has difficulties that invite an attempt at elucidation, as do the tertiary orogeny and the tertiary sedimentary record. These phases and phenomena of the science are presented and handled by capable men, who assay the ore offered by the latest discoveries and deductions. They reconstruct the past from its relics in the present, and read the record of the heroic ages as it lies graven in the hieroglyphs of nature's adamantine pages. The illustrations comprise maps and charts, both rare and typical formations, and sketches of bones and interesting restorations. The volume serves to publish a large amount of accurate information that carries light to many of the darker passages of our strati-form records.

THE PROBLEM OF VOLCANISM. By Joseph P. Iddings, Ph.B., Sc.D. New Haven: Yale University Press, 1914. 8vo.; 273 pp.; illustrated. Price, $5 net.

The material of this volume was first prepared as lectures for the Silliman course at Yale University during 1914. It deals with a subject that, involving many of the fundamental problems of geology, is conditioned upon so many conceptions and relationships of the earth and the solar system that its complexity is bewildering. Yet these lectures are couched in language that, avoiding so far as may be technical terminology, presents these conceptions and relationships so clearly that the layman may grasp their essentials. Full page plates of volcanoes abound, while many other such plates show the nebulæ in a remarkably clear manner. The physical characteristics of the earth, its petrology and its dynamical status, are incisively discussed, and the extravasation of molten magma, the intrusion of igneous magmas within the lithosphere, and the extrusion of lavas upon the earth's surface, make up the last three lectures. Altogether it is a thoughtful work, presenting its problems forcefully and comprehensively, and handling its speculations in the brightest light that the ablest minds have been able to throw upon this paramount question of physical geology. The hypotheses advanced in explanation of volcanic phenomena are carefully developed, and their modifications under stress of time and wider knowledge are indicated. But it is the problem itself that occupies the author rather than the supposed explanations, and by the aim of a book must the book be judged. From this viewpoint it is distinctly a successful achievement, to be unqualifiedly commended to all students of geology in general or of volcanic activity in particular.

DIE MILCHSTRASSE. Von Dr. Friz Kahn. Stuttgart: Kosmos Gesellschaft der Naturfreunde, 1914.

This is a well written, popularly worded treatise on the Milky Way which can be recommended to those who can read German.

GRAPHIC METHODS FOR PRESENTING FACTS. By Willard C. Brinton. New York: The Engineering Magazine Company, 1914. 4to.; 371 pp.; illustrated. Price $4.

The author, eliminating mathematics and technical terms, presents his subject so that the man devoid of any statistical training may readily appreciate and apply the methods. The work is so arranged that the hard-driven legislator, business or social worker may find the section and the chart most nearly related to his needs with a minimum loss of time. In works of an instructive aim, it is becoming more and more customary to show examples of bad practice as well as of good. Certainly, in cases where what not to do is as important as the opposite knowledge, this procedure is helpful in a high degree. Mr. Brinton has followed the practice with good results, accompanying his examples with sound criticism. The field he seeks to cover has so far been neglected by writers and, considering this lack of recorded knowledge, the author has achieved a more than fair measure of success. Among other aspects of the subject, the reader is initiated into simple comparisons, time charts, curve plotting, map representations, curves and records for the executive and corporation financial reports. Anyone desirous of preparing charts for publication will find it easy, with the aid of this handbook, to give the draughtsman a clear understanding of his requirements.

EFFICIENCY IN THE HOUSEHOLD. A Book for Every Woman. By Thetta Quay Franks. Garden City, N. Y.: Doubleday, Page & Co., 1915. 8vo. Price, $1.50 net.

"Efficiency in the Household" is almost wholly a book of chronological forms, two pages to the day, which gives menus for each meal of the day, repeating after three weeks. Below is an order list, with blank spaces under such headings as meats, vegetables, and groceries. At the month's end, the bills and these order lists should agree. On the opposite page may be noted the guests entertained during the day. The menus given, while catering to differing tastes and incomes, are essentially economical. Neither chicken, game, nor the choice cuts of beef are included, and it is estimated that the meals may be served at an average cost of about 21 cents per person. A long preface is full of valuable material, and the compiler aims at combining in the American housewife the common-sense of the English, the thrift of the French, the organization of the German, and the facility of the Italian. A price-list precedes each monthly programme. Ten or fifteen minutes' time daily will suffice to establish the system in any household.

THE CREATION OF WEALTH. Modern Efficiency Methods Analyzed and Applied. By J. H. Lockwood. Cincinnati: The Standard Publishing Company, 1915. 8vo.; 225 pp. Price, $1 net.

"The Creation of Wealth" is meant for the general reader who wishes to grasp, without too intense application, such aspects of the business world as touch most of us closely. That which has been approached from its practical side by Emerson and Taylor, expounded psychologically by writers like Münsterberg, and discussed from a humanitarian viewpoint by others, is here dealt with in a somewhat different manner. The ingredients of wealth are land, labor, capital, and that elusive element, brain. It is with the last, the most neglected of the four ingredients, that Mr. Lockwood seeks to throw a clearer light upon the whole subject. He attempts an inventory of accomplishment, forecasts the immediate future, and incidentally essays "a working theory of industrialism." His discourse is brightened and strengthened by numerous sketches of famous men and their achievements, and the theories of socialism, of the single tax, and of special privilege are simply presented. Character is made the base of the ideal pyramid of which training and opportunity lead on to efficiency and wealth. The result is a readable and instructive volume worthy of careful perusal.

STABILITY AND EQUILIBRIUM OF FLOATING BODIES. By Bernard C. Laws, B.Sc., A.R.C.Sc. New York: D. Van Nostrand Company, 1914. 8vo.; 251 pp.; illustrated. Price, $3.50 net.

The advent of submarines and aircraft made demands upon our knowledge of equilibrium and stability which that knowledge could not adequately supply. Even now, after years of research and experiment, there is much to discover and to reduce to practice. Mr. Laws's concise work deals with aspects of the subject that have not hitherto been brought together in one volume. He regards floating bodies as subject to active as well as passive forces; he applies the principles of liquid and gaseous pressure both to bodies at rest and bodies in motion. Chapters are devoted to ships, floating docks, submarines, aircraft, and caissons. The author's long study and ripe experience in the scientific side of shipbuilding is freely drawn upon for data and experimental results. Where the subject oversteps his own especial line of research, great effort has been made to maintain the accuracy of the arguments and the value of the deductions. Needless to say, a fair knowledge of rigid dynamics and hydromechanics is necessary to an understanding of this work. For those who wish to pursue the historical side of the subject, or to further develop any branch of this science, frequent reference is made to publications and papers that fill their requirements.

ON SUNSET HIGHWAYS. A Book of Motor Rambles in California. By Thomas D. Murphy. Boston: The Page Company, 1915. 8vo.; 376 pp.; illustrated. Price, $3 net.

In his latest work Mr. Murphy deserts Europe, the scene of his former recorded journeyings on the inflated tire, and turns not unwillingly to the glamors of our own California. He is enthusiastic in his appreciation of this "motor paradise," and his glowing word-pictures soon induce a similar state in the reader. To this end the many exceptional colored plates substantially contribute. They are from the works of such artists as Morgan and Moran, while some forty mellow duogravures add their appeal and vitalize the written description. The author promises us that California's good-road mileage will rapidly expand, thus throwing open to the motorist a wealth of romantic history and varied scenic splendor with which few countries can vie. While not a guide-book in the accepted sense, the work will prove a charming and useful companion to the traveler. The State road map showing the principal automobile roads is presented as a folding insert, and adds materially to the practical value of the work.

TELL-ME-WHY STORIES ABOUT ANIMALS. By C. H. Claudy, New York: McBride, Nast & Co., 1914. 8vo.; 209 pp.; illustrated with colored plates. Price, $1.25 net.

A book of fireside tales for children aiming to give them some knowledge of evolution.

THE ORDINARY PHYSICAL UNITS, MECHANICAL, THERMAL, ELECTRICAL. By E. S. Elder, Kansas City, Missouri: The Hyde Park Press. Price, 15 cents.

"The Ordinary Physical Units, Mechanical, Thermal, Electrical, Defined, Compared, Correlated," is a small pamphlet of a size to be slipped under the cover of a text book, and thus to be always ready for reference. It will enable one to find any unit and its value with little loss of time. If we were to make any criticism upon it, we should say that it was too much condensed, but in actual use one would soon get accustomed to the arrangement of the matter. The price places it within the reach of classes in schools, especially as liberal discounts are made upon large orders.

EXPORTERS' ENCYCLOPAEDIA. 1915. Containing Full and Authentic Information Relative to Shipments for Every Country in the World. New York: Exporters' Encyclopædia Company. 8vo.; 1,152 pp. Price, $7.50.

The eleventh edition of the Exporters' Encyclopædia is a compilation that may not be ignored. It furnishes under one cover just the indispensable information necessary to the man or the firm that ships goods abroad. It offers an alphabetical list of countries, with routes from American ports. It gives the ocean steamship lines and their agents, with freight rates. It discusses the effect of the war upon our export trade and offers suggestions for selling our goods abroad. It gives foreign coinages, and foreign weights and measures, with their American equivalents. Foreign import duties are listed, and custom house clearances explained. Foreign parcels post and postage rates make up a valuable section. The main body of the text is devoted to the area, population, commerce, products, etc., of the countries of the world, and a list of American consulates in foreign cities is appended. The wide scope of the work, its accuracy, and the accessibility of its contents, make up a desk book that offers hourly aid to the shipper. Monthly "correction notes," furnished free to subscribers, may be inserted in the proper section as they are received, and keep the volume strictly up to date.

PENNSYLVANIA TREES. By J. S. Illick, A.B. F.E., Professor of Dendrology and Forest Management, Pennsylvania State Forest Academy. Issued by direction of the Commissioner of Forestry as Bulletin 11 of the Department of Forestry of Pennsylvania, 1914. 231 pages, 103 photographic illustrations and 129 full pages in pen drawings.

This is one of those useful and well-arranged hand-books which are so important to many, and one which has long been required. It is admirably arranged and full in detail, well printed and thoroughly illustrated and is, moreover, to be had for the asking—all great inducements for insuring an extensive distribution among the large class of men and women who are interested in trees and general forestry. The above valuable work can be recommended with real pleasure, because it contains a large amount of extremely useful information in a condensed form. The book is divided into two parts. Part I contains a brief popular discussion dealing with the subject of forestry in a general way. It is intended primarily for the layman and for the beginner of forestry. Among other things, the author discusses the structure, development, protection and value of forests with special reference to conditions in Pennsylvania. He gives also a description of the parts of the trees, such as the bark, twigs, buds, leaves, flowers, fruit, wood, etc., a knowledge of which will enable one to understand the part that follows. Part II is essentially a manual of the forest trees of Pennsylvania. It comprises a discussion on the identification of trees and a description of families, genera, and species with analytical keys. About 130 species of forest trees are described and neatly illustrated by means of pen drawings. By no means the least valuable part of these discussions of individual trees is the information in reference to the properties of the woods and the economic importance of the species. The general get-up of this part of the book reflects credit on the author, and the lay reader who will study it can not fail to gain much valuable instruction.

STATISTICAL ATLAS OF THE UNITED STATES. Prepared under the direction of Charles S. Sloane, Geographer of the Census. Washington: Government Printing Office, 1914. 4to.; various paginations.

The cover-title of this work is "Statistical Atlas of the United States 1914," and a portion of the statistical information it contains is brought down to the year 1913. The work is, however, primarily the atlas of the Thirteenth Census, and is based mainly on the statistics of 1910, together with those of the previous decennial censuses when required for the purpose of comparison.

The Statistical Atlas of the United States has been published every ten years since the issue for 1870, though that of 1880 was an unofficial undertaking. It is probably unique among government publications; i. e., no foreign government, so far as we know, presents a corresponding body of national statistics in the same compact and convenient graphical form. Yet this extremely useful work does not appear to be well known to the public; nor, perhaps, to geographers, if we may so infer from the fact that the edition of ten years ago, prepared by the lamented Henry Gannett, received no mention in the leading geographical journals of the world. The new atlas is a collection of more than 500 plates, each of which contains, on an average, two charts or diagrams. Preceding the plates are 100 pages of descriptive and explanatory text. About half the work is devoted to statistics of population. Under this head are given, *inter alia*, a series of national and State maps showing the density of population throughout the country, and the fluctuations of the same from decade to decade. A considerable amount of space is given to the somewhat abstruse subject of the "center of population" of the United States, and its migrations. In 1790 this point was 23 miles east of Baltimore, Md., while in 1910 it was at Bloomington, Ind. We also have in this edition, for the first time, information concerning the centers of population of the several states with their migrations since 1880, and statistics as to the past and present location of the centers of negro population and foreign-born population. Other demographic statistics presented in the charts and graphs relate to such topics as illiteracy, immigration, martial condition, sex distribution, etc. The next section of the work is devoted to agriculture, including charts showing the distribution of a wide range of crops, rural industries, economic conditions in connection with rural population, etc. Here, again, we have individual State maps, as well as maps of the country as a whole. The remaining groups of maps and diagrams pertain to manufactures, mines and quarries, cotton, financial statistics of cities, vital statistics, religious bodies, marriage and divorce, and insanity. The Statistical Atlas would perhaps be more interesting and many of the facts it now presents would be more readily understandable if it included a group of well-selected physical charts. The only chart of this character in the edition under review is one showing the mean annual rainfall of the United States.

## Notes for Inventors

**Color Photography.**—In patent No. 1,126,689, Rodolphe Berthon and Maurice Audihert of Villeurbanne, France, describe a photographic apparatus for color photography which has an objective for projecting an image and concentric prisms which break the image into monochromes projected through a three color screen onto a sensitized surface.

**Fire-Bucket and Waste-Can Combined.**—George W. Lorimer, of Piqua, Ohio, has patented a combined fire-bucket and waste-can, No. 1,100,837, in which the waste-can and fire-bucket are so associated that the practically daily attention to the waste receiver or can will insure attention to the fire-bucket, so the latter will always be in condition for efficient use.

**Recognition of a Woman's Invention.**—In rendering a decision in the U. S. Circuit Court of Appeals Ninth Circuit, Justice Gilbert in Hyde v. Minerals Separator Limited took occasion in referring to the Everson patent No. 348,157 to say "Miss Everson was the first to make the important discovery that the affinity of the oil for the metal was increased by the addition of an acid."

**Chinese Imitation Not Necessary.**—In Bush & Lane Piano Company v. Becker Brothers, 209 Fed. 233, it was held that to constitute an infringement of a design patent it is not essential that the copying design should be a Chinese copy of that of the patent, but it is sufficient if it imparts to the mind the same general idea of appearance and ornamentation so that purchasers might be deceived.

**A Drinking Vessel of Ice.**—Hendrik Douwe Pieter Huizer of The Hague, Netherlands, has patented No. 1,123,537 an apparatus for manufacturing drinking vessels in the form of tumblers of ice, suggesting that besides the cooling effect of the ice drinking vessel there is a further hygienic advantage in that it can only be used once, also that the life of the vessel can be lengthened by insulating it thermally by a paper or celluloid case, also by giving it a special form and using special precaution in making it.

**Two Patents for Newspaper Improvements.**—Edgar H. Cottrell, of Westerly, R. I., has secured two patents No. 1,126,405 and No. 1,126,406 for newspapers. In No. 1,126,405 one page of the newspaper is printed on one side of one sheet and another page is printed on one side of another sheet and the remaining pages are each printed partly on one sheet and partly on another sheet, the idea being to avoid the difficulties in holding the paper as usually printed when unfolded. In No. 1,126,406 the newspaper has its assembled leaves secured together along a line extending transversely across the middle of the printed pages and the printed matter is so arranged that the first half of the paper may be read from front to back by turning the leaves over in one direction and the remaining half of the paper may be read from back to front by reversing the paper and turning the leaves over in the opposite direction.

**Specifications and Drawings of Patents.**—According to the monthly catalogue of the Superintendent of Documents, the bound volumes of patent specifications and drawings constitute the largest series of public documents thus far issued by the United States Government. They were first published in weekly volumes, beginning May, 1871; August, 1872, the form was changed to a monthly volume; July, 1885, the issue of semi-monthly volumes began; while since January, 1903, three volumes a month have been issued, many of them being very bulky. By virtue of the Sundry Civil Act of August 24th, 1912, this series is to end with the three volumes corresponding to June, 1912; but the publication is much in arrears, and has now only reached June, 1911. The whole series will include 974 books, mostly of mammoth size, filling about 350 feet of shelf-room. Although the issue of bound volumes has been discontinued, the specifications and drawings of patents will continue to be printed in "slip" or pamphlet form and sold by the Patent Office.

## LEGAL NOTICES

## Welding Water and Gas Mains

(*Concluded from page 272.*)

sirable, to make the joint stronger than the tube by the simple procedure of adding a thick layer of new metal.

It might be thought that ruptures would occur because of expansion and contraction under variations in temperature. To settle this question, a severe experiment was tried in England. A long length of welded pipe was provided with a heavy concrete abutment at either end, the interior was put under a pneumatic pressure of 100 pounds per square inch and a daily fluctuation of temperature through a range of 80 deg. Fahr. provided for a period of one month. At the end of the time the joints were still intact.

In laying pipes by the new method, it is often convenient to join up a long straightaway section on the surface of the earth and then roll or slide it into place in the bottom of the ditch. In welding the joints of straightaway sections, it is sometimes possible to elevate the portion at the end where the new joint is to be made. That is, a support will be put under this end and a little farther back another but lower support. As the welds are made, the two supports are advanced and the line settles down on the earth to the rear. Another method is to weld the pipe at the surface, but supported over the ditch by cross pieces of wood.

At times joints are made after providing a working space by excavating beneath the pipe as it lies in final position at the bottom of the ditch. Such excavations are especially required where two sections have to be joined which have already been made up by a more convenient procedure, or where there is an angle or a complicated system of joints.

It might be thought that the new molten material could be allowed to flow down to the lower side of the pipe and automatically make the joint without especial assistance from the workman, but this is not the case. When two such refractory metals as the steel of the pipe and the Norway iron of the welding rod have to be joined, *both* must be at or near actual fusion at the surfaces of contact, and the weld must be made little by little. No "wholesale" procedure is applicable in this process. When a long length is to be welded up on the surface it is often possible to avoid welding underneath. The welder operates continually at or near the upper side of the joint, while helpers roll the pipe slowly over.

In making the welds, it is not necessary to have bell and spigot ends, but one edge is brought up to the other. If they have been properly prepared by beveling at an angle of 45 degrees a 90-degree groove will thus be formed, but beveling is not necessary. Square edges may be welded, butt to butt, provided a small interval is left between the two edges to provide access for the welding flame. Where the metal is thin no interval is required, as the flame will heat the metal all the way through.

A foreign invention provides a special joint. The two pipe ends which are to be welded are arranged to telescope for a short distance, the surfaces of contact being conical, so that it is possible to get a fairly tight joint by purely mechanical means. The edge of the larger end is rather sharply flared, thus providing an annular space for the new metal added in the welding procedure. When welded in this way the joint is particularly strong and impermeable.

Whenever welded lengths are to be put into the ditch it is not necessary nor altogether desirable that they should be handled with excessive care. A little roughness has the advantage that it provides a test before the pipe is covered up. If the joints fail, it is preferable to know of the weakness at once, when correction is a simple matter.

Gas welding has been employed in making joints where pressures were excessively high. The steel pipe line serving a hydro-electric power house in one of the Western States developed leaks soon after the water was first turned on. The pipes were large, the metal thick, and the pressures ran up to 800 pounds per square inch. The leaks were numerous and serious. In fact, if gas welding had been unequal to meeting the difficulty, a considerable section of line would have been a failure. The seams were made by riveting straps of steel over the butt joints between edges of steel plates. The seams made in the shop were good; those made in the field were defective. By means of the oxy-acetylene blowpipe, the joints were made strong and tight. This work was done without removing the pipe from its bed.

Here, too, expansion and contraction seem to have produced no real trouble, and yet some of the lengths involved were considerable. Steel expands or contracts about 0.0000066 along its linear dimensions for each degree Fahrenheit. A thermal variation of 50 degrees would, in the case of a 100-foot length, add or subtract 2/5 inch, and we might expect serious results from such movements. However, the fact that a pipe is fairly free along two dimensions is probably the reason why it may be held fast along the third. Whether railway rails may be joined together and made into a single piece is a very similar question, and just as interesting.

## Methods by Which the European War Has Been Filmed

**By Ernest A. Dench**

IN taking pictures at the front, the motion picture camera man has been confronted with no ordinary task. He is exposed to as many risks as the soldiers themselves, not counting the fact that he is greatly resented by the warring powers, who place various restrictions in his way.

Cherry Kearton made many attempts to film exploding shells at the Battle of Alost, but he found that they were barely noticeable on the screen—there is a flash and that is all. When one strikes a poor soldier he slips forward a little and stirs no more. Mr. Kearton states that if there are dense volumes of smoke and the soldiers fling their rifles up in the air, then die in a pose, such films are fakes. In warfare to-day smokeless powder is the only kind used, it being in universal demand because it does not give their position away to the enemy.

The operators of a well-known French company had their cameras equipped with a telephoto lens, by the aid of which it was possible to cinematograph soldiers at work in the trenches at a distance of six hundred yards. By this means they could get close range views of the fiercest fighting; the ordinary lens is limited to a range of two hundred feet.

Most other camera men have dispensed with the cumbersome motion picture machine and instead used an aeroscope camera, which is minus a tripod and, therefore, easy to carry about. But even this does not frighten all the difficulties away.

To keep the camera steady when carrying out his work Mr. Mason was obliged to adopt sundry plans. The most successful one was to strap the camera to the trunk of a tree, which, also afforded protection for the operator. At another time, wanting to obtain pictures of the Belgians fighting in the trenches, Mr. Mason laid himself flat in the middle of the street and held the camera up in front of him.

His one great scoop was a set of remarkable panoramic views of the German army. To photograph these he attached a coil of wire to the machine, tying the other end to a button on his coat. He then climbed up a telegraph pole, and after reaching the top he tugged at the wire and thus got the camera up safely. The final operation was to hold it tightly and focus the camera on the magnificent sight ahead of him.

M. Bizeul hit on the ruse of employing the second-story room of a restaurant opposite the Ghent town hall. He opened the window just wide enough to permit the lens to pass through, and when the Germans did arrive he filmed continuously from 3 o'clock to 4:15 in the afternoon.

The greatest task of all is getting the stuff past the censor at the front, who hacks the film to pieces unmercifully. Smuggling, therefore, is often resorted to and many are the methods by which the officials are dodged. Paul Rader, a plucky

American, managed to film pictures of an artillery duel between the French and Germans, after which he rushed to the nearest vacated house and hid both camera and film in the cellar. A few days later, when the fighting had shifted to another part of the country, he returned for his belongings and was successful in eluding the vigilance of the authorities on his journey to the coast, *en route* for England.

### The Current Supplement

IN Modern Ideas of the End of the World, in the issue of the SCIENTIFIC AMERICAN SUPPLEMENT for March 20th, No. 2046, readers will find an able review of theories, and a valuable contribution to cosmology that is full of interest not only to every physicist, but all well-informed people. Gasoline from "Synthetic" Crude Oil will be especially acceptable at this time when so many are engaged on problems relating to the fractional separation of petroleum, as it tells of some remarkable experiments on a process by which a considerable additional yield of gasoline was secured. The Gardens of the Zoological Society of London, with its pleasing illustrations, gives something of the history and organization of a celebrated institution. A New Era in the Science of Nutrition tells about an important work by noted specialists that is of interest to everyone. The Cutlery Works at Thiers tells a readable story, with illustrations, of the methods of manufacture at one of the oldest and most important cutlery centers in Europe. The Reactions of the Planets on the Sun discusses the influence exerted by the earth, and considers the question of sun-spots from a new point of view. The article on Gyrostatic Reaction is concluded; and there are the usual assortment of valuable short articles, including some account of recent developments in X-ray tubes, hydrogen and the rare gases and conditions of industrial accidents. A number of valuable new books are also described.

### Finger Prints in the Army

THE last report of the Adjutant-General, United States Army, contains interesting information as to the use of the finger-print method of identification in the army, including some striking instances of the utility of this method. To the end of the last fiscal year a total of 291,181 finger-print records had been received in the Adjutant-General's office, of which 88,937 were made in cases of re-enlistment, when the records made during previous service were already on file. It is found necessary to obtain finger-print records of men claiming previous service, for the purpose of detecting cases, several of which have been discovered, in which a man with a discharge certificate in his possession claimed the service represented by, and enlisted under the name appearing in, that certificate, although his finger-print record established beyond a doubt the fact that he was not the man he claimed to be. During the fiscal year 467 cases of fraudulent enlistment of former deserters, general prisoners and others were discovered through the finger-print system. The office has also identified by means of this system dead men who were former soldiers and whose identity could not be satisfactorily established in any other way, as well as civil offenders who sought to evade arrest by enlisting in the army under assumed names, and soldiers who left impressions of their fingers while in the act of committing serious offenses.

**Keeping the Eye on the Golf Ball.**—In patent No. 1,126,051 the inventor provides for preventing the player from raising or turning his head and thus forcing him to keep his eye on the ball by supplying a harness in which an anchor member in the form of a strap or band encircles the chest and an elastic tube projects therefrom and is held by the teeth of the player so that when he starts to move his head to one side or the other, he will feel the pull on the elastic tube and will be reminded of the fact that he should face to the front and keep his eye on the ball. Apparently golf isn't hard enough.

## Notes and Queries.

Kindly keep your queries on separate sheets of paper when corresponding about such matters as patents, subscriptions, books, etc. This will greatly facilitate answering your questions, as in many cases they have to be referred to experts. The full name and address should be given on every sheet. No attention will be paid to unsigned queries. Full hints to correspondents are printed from time to time and will be mailed on request.

(13049) C. L. C. asks: Has there ever been a motor constructed by using permanent magnets as motive power, or does this come under the head of perpetual motion? A. There never has been a motor constructed the power for which was obtained from permanent magnets. Nor is it likely that such a motor will ever be built; since one pole of a magnet attracts and the other pole at the same instant repels with an equal force, their resultant force is zero. Since it is not possible to make a magnet with only one pole, it is impossible to get rid of this equal attraction and repulsion of two poles. A magneto whose field was made by permanent magnets was in use before the dynamo was invented. The telephone ringer is such a machine, and a motor with permanent magnets in the field and a commutated current in the armature was also devised long ago. Such a motor would certainly be a perpetual motion machine, if it did work without any supply of power outside of itself.

(13050) J. A. F. asks: Please answer the following query: The saliva in the mouth being an alkali, and the stomach juices being acids, and as alkalies counteract acids (also *vice versa*), how is it that it is generally recommended by most physicians to mix food thoroughly with saliva before swallowing? A. The saliva has a two-fold action in digestion. The first is to moisten the food and to assist in forming dry food especially into boluses so that it can be easily swallowed. The second action is chemical, in which the carbohydrates of the food have the first act of digestion performed upon them. The starches are first broken down into dextrine and then into maltose. Thus the first step in digestion takes place in the mouth, and it is a very important step too. Thorough chewing of the food is important in order to mix the saliva thoroughly with the food and it gives it time for its peculiar action before the food passes on to the gastric stage of digestion. Saliva is but slightly alkaline.

(13051) E. B. H. asks: 1. Can you answer the following questions in your Notes and Queries Department to settle an argument? Compressibility of sea water compared with solid steel. (I figure the elastic modulus of sea water to be 294,000, which would cause sea water to be dense enough to hold solid steel suspended at the bottom of a suppositional pit in the ocean, 110 miles below the surface.) A. Sea water is compressed $44 \times 10^{-6}$ per atmosphere, according to the Smithsonian Physical Tables, page 83, which we will send for $2 postpaid. At the bottom of the ocean in the deepest place known this would give a density about 1/20 greater than at the surface. There are no places as deep as 110 miles in the ocean. The Nero Deep is 31,614 feet, and the Planet Deep is 32,086 feet, or 406 feet more than 6 miles. No place has been found where the sounding wire has not reached the bottom. We may feel reasonably certain that we know the deeps of the ocean. The recent book by Murray, "The Depths of the Ocean," which we will send for $7.50 postpaid, gives the story of the searching of the ocean for the facts of its history. We may reasonably dismiss the discussion of a "supposititous pit" in the ocean. By the same authority referred to above, steel is compressed $68 \times 10^{-6}$ per atmosphere, or more than 50 per cent more than water at the same pressure. Therefore, as a solid steel ball should descend in the water it would be compressed half as much again as the water at the same depth. You can see that there could be no depth at which water would become as dense as steel, and therefore no place where a steel ball would remain in suspension in the ocean, even if there were a pit reaching to the center of the earth. 2. Is the pressure sufficient to collapse the best braced ship before the water itself becomes dense enough to hold the ship suspended? That is, is a ship with hatches tightly closed, and bulkheads hermetically sealed, bound to sink to the bottom of the ocean, provided it is heavy enough to sink when say 100 feet below the ocean surface? A. The density of sea water averages 1.025. This would cause an increase of pressure of one atmosphere for each 33.17 feet of descent. At the bottom of the Planet Deep the pressure is almost 1,000 atmospheres, or about 7½ tons per square inch. It is safe to say that ordinary bracing of a compartment containing air could not withstand this pressure. Another inference which we have often stated in Notes and Queries is that anything which sinks at the surface of the water will go to the bottom anywhere in the ocean. Nearly everything is more compressible than water. Glycerine and mercury are the only materials given in the Smithsonian Tables which are less compressible than water. Of course there may be other liquids not yet measured, but it is very unlikely that there are any solids less compressible.

(13052) T. E. P. asks: 1. Suppose a train going at the rate of 60 miles an hour. If a bird were liberated inside the car, and just simply remained stationary, fluttering his wings as they often do, would it remain in the same position, or would the end of the car strike it? A. If the windows and doors of a car are closed, the air



ELECTRIC LIGHTING FOR AMATEURS
How a small and simple experimental installation can be set up at home. Scientific American Supplement 1551. Price 10 cents. For sale by Munn & Co., Inc., and all newsdealers.

in the car is carried along with the car, and is at rest with reference to the car. A bird or anything else floating in the air in the car is carried along in the same way, and will not be moved toward the rear end of the car. If there was a draught of air toward the rear of the car, you would feel it on your face and the feathers on the hats of passengers would be blown by the wind caused by the drifting of the air toward the rear of the car. 2. Which end of the Panama Canal is the higher, if either—the Pacific or the Atlantic? A. The ocean ends of the Panama Canal are at the same level. There is no difference of level between the Atlantic and Pacific oceans. There is a difference between the rise and fall of the tides at the two ends of the canal. At Colon the total change of level of the tides is 2.5 feet and at Panama it is 21.1 feet. The difference in level on the two sides varies thus 18.6 feet. This is wholly due to the rise and fall of the tides, and not to any difference of level between the two oceans. These figures are taken from an address by Col. Goethals before the National Geographic Society, for which see the *National Geographic Magazine* for February, 1911, page 155.

(13053) S. G. asks: In order to determine a question which has arisen between several friends and myself, I am taking the liberty of asking the following questions: Is it possible for any form of life, particularly the lower forms of insect life, to be produced spontaneously? The reason I am asking these questions is because the assertion was made several days ago that some kinds of insects, such as lice, ants, bedbugs, etc., appear without any reason for so doing. This statement appears to me to be utterly absurd and without any foundation of fact, but seems to be a very popular belief. For instance, it was said that if two flat pieces of a certain kind of wood were dampened and placed together, and left for the proper length of time, a certain species of bedbug, known as a wood bedbug, would be found. Another said that certain varieties of worms were generated from decayed wood, and also that ants appeared in places where it was impossible for them to enter. Still another believes in the horsehair snake superstition, so it is in the belief that you can clear up some of these stupid beliefs that I am writing you at such length. Perhaps you can also explain the wrigglers in vinegar and the mites in cheese. A. No life has yet been produced from lifeless matter spontaneously. In all the experiments in that direction the experiment begins with organic matter. It must be evident to you that if two pieces of wet wood are laid away there must be many germs upon their surfaces, some of which may go on and produce forms of living creatures. The experiment which you describe is not a scientific experiment at all. It does not exclude the germs of living creatures. The hair-like worm to which you refer is the *Gordius aquaticus*, which is fully described in the books upon zoology. It is a parasite in locusts and some other insects for a part of its life, and spends another part in certain fishes. In its final state it is a free-swimming, snake-like worm, which many ignorant persons suppose to be a transformed horsehair. The vinegar eel is also a worm, known in science by the name *Anguillula aceti*, or the little snake of vinegar. The cheese mite is not a worm, but an insect, which occurs in cheese and flour and in milk. Packard's "Zoology" describes all these. We send the book for $2.50. The cheese mite is known in zoology as the *Tyroglyphus siro*. There is a variety which is found in fermenting sugar. It is often shown upon dates by the venders of cheap microscopes, just as the vinegar eel is shown.

(13054) E. S. B. asks: I inclose a clipping from a recent periodical entitled "Falling East," which is so entirely contrary to generally accepted notions that I would be very glad indeed to have an expression of opinion from someone who is able to either substantiate or prove the errors of this article. A. The idea that the rotation of the earth ought to cause bodies dropped upon its surface to fall to the east of the point directly below that from which they were dropped was first suggested by Sir Isaac Newton near the beginning of the eighteenth century. Up to recent years the best experiments upon this matter were performed at Hamburg, Germany, in 1802, and at Freiburg, in Saxony, in 1831. The experiments are difficult because of air currents, and also because a ball which is not perfectly spherical will sheer off to one side or the other in falling. The German experimenters had only 530 feet of fall for their balls, and obtained an eastward deviation of 1.24 inches. In the experiments described in the article "Falling East" the Americans had a mine shaft 5,300 feet deep into a copper mine at Calumet, Mich. At Calumet the surface of the earth is moving eastward about 1,000 feet a second. At the depth of 5,000 feet the eastward motion is about 4 inches per second less than the surface. To drop the 5,000 feet without any resistance from the air would require 17½ seconds, and it would in that time deviate toward the east about 6 feet. But the resistance of the air would greatly increase the time of fall, so that the easterly deviation would be much more than 6 feet. A ball which was started from a point 4 feet from the wall was found lodged in the timbers on the east side of the shaft 800 feet below the surface. Another ball was never found. It is hidden somewhere along the east side of the shaft. An inference from this is that a load of ore dropped into the shaft at its mouth would be found scattered along the east wall of the shaft, or in the lower levels on the east side of the shaft. Our information is obtained from an article in *Machinery*, New York, for February, 1914, which reports the work of the party from the Michigan School of Mines at Houghton, Mich., which is in the copper country, only a few miles from Calumet

# Danger Pennies

## *How false economy in lubrication often proves a boomerang*

LET us look at some plain arithmetic. Suppose your car cost $1200.

At the end of the year, you reckon expenses and, roughly, you find:

| | |
|---|---|
| **Depreciation in selling value, say** | **$400.** |
| **Tires, approximately** | **100.** |
| **Repairs** | **?** |
| **Gasoline, 5000 miles at 1c a mile** | **50.** |
| **Insurance, say** | **65.** |
| ***Lubrication, perhaps as much as*** | **10.** |
| | **$625. plus** |

Lubrication comes last—at a trivial $10. a year.

It is a human failing to treat such small outlays lightly.

Some motorists do not yet realize that oils which can be sold at pared-down prices cause pared-down efficiency, and send total yearly expenses up—not by mere penny steps but by real dollar leaps.

Consider *depreciation:* Why does it loom up so large?

*Not enough attention to that $10. a year.* When all cars are given efficient oil for their motors, automobiles will command higher resale prices.

Trace back most *repair bills* and again you find—*not enough attention to that $10. a year.*

*Gasoline consumption mounts up.* The experienced motorist knows that efficient lubrication insures a higher mileage from gasoline.

This is certain: Cheap, poor-wearing oils make noisy, quick-wearing motors.

And worn motors soon wear out.

If you use the grade of Gargoyle Mobiloils specified for your car in the chart below, you may spend an added few cents a gallon. But the gallon "wears" longer.

Gasoline mileage is increased and avoidable repair bills and depreciation are eliminated, adding years to the life of your car.

If you decide in favor of *true* economy in lubrication, you will find your scientific guide in our Chart of Automobile Recommendations which represents our professional advice.

If your car is not listed, a complete chart will be sent you on request.

In buying Gargoyle Mobiloils from your dealer, it is safest to purchase in original packages. Look for the red Gargoyle on the container.

The four grades of Gargoyle Mobiloils for motor lubrication, purified to remove free carbon, are:

**Gargoyle Mobiloil "A"**
**Gargoyle Mobiloil "B"**
**Gargoyle Mobiloil "E"**
**Gargoyle Mobiloil "Arctic"**

For information, kindly address any inquiry to our nearest office.

VACUUM OIL COMPANY
Rochester, N. Y., U. S. A.

**Specialists in the manufacture of high-grade lubricants for every class of machinery. Obtainable everywhere in the world.**

*Domestic Branches:*
Detroit, New York, Philadelphia, Minneapolis
Boston, Chicago, Indianapolis, Pittsburgh

# A guide to correct Automobile lubrication

***Explanation:*** In the schedule, the letter opposite the car indicates the grade of Gargoyle Mobiloils that should be used. For example: "A" means Gargoyle Mobiloil "A." "Arc." means Gargoyle Mobiloil "Arctic." For all electric vehicles use Gargoyle Mobiloil "A" for motor and enclosed chains. For open chains and differential use Gargoyle Mobiloil "C." The recommendations cover all models of both pleasure and commercial vehicles unless otherwise noted.

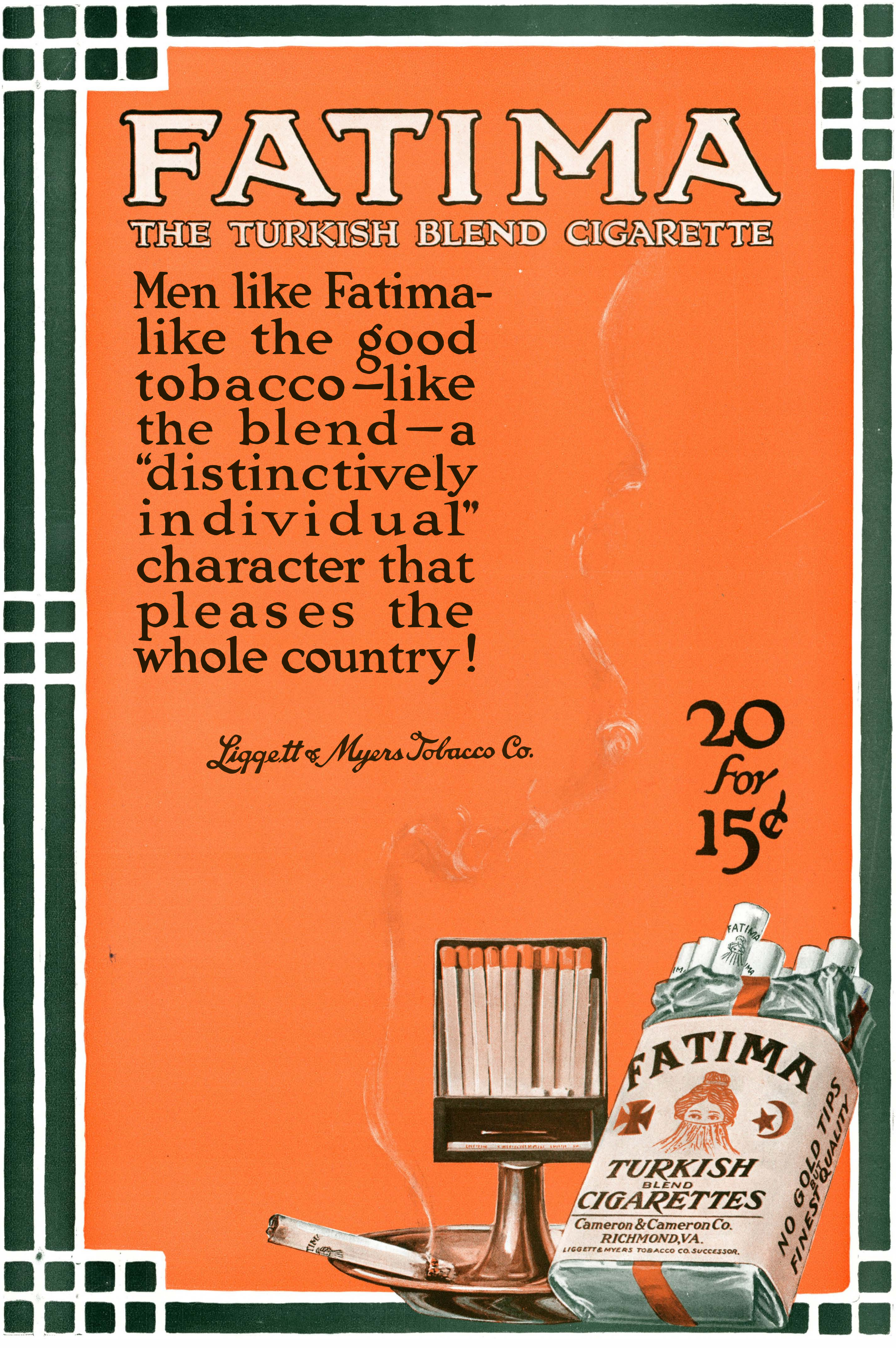
| MODEL OF | 1911 | | 1912 | | 1913 | | 1914 | | 1915 | |
|---|---|---|---|---|---|---|---|---|---|---|
| CARS | Summer | Winter | Summer | Winter | Summer | Winter | Summer | Winter | Summer | Winter |
| Abbott Detroit | A | Arc. | A | Arc. | A | Arc. | Arc. | Arc. | ... | ... |
| Alco | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | ... | ... | ... | ... |
| American | A | Arc. | A | Arc. | A | Arc. | A | Arc. | ... | ... |
| Apperson | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. |
| Auburn (4 cyl) | A | A | A | A | A | A | A | A | A | Arc. |
| " (6 cyl) | ... | ... | ... | ... | ... | ... | Arc. | Arc. | Arc. | Arc. |
| Autocar (2 cyl.) | A | Arc. | A | Arc. | A | Arc. | A | Arc. | A | Arc. |
| " (4 cyl.) | A | Arc. | A | Arc. | ... | ... | ... | ... | ... | ... |
| Avery | A | E | A | A | A | A | A | A | A | A |
| " (Model C) 1 Ton | ... | ... | ... | ... | ... | ... | Arc. | Arc. | Arc. | Arc. |
| Buick | A | Arc. | A | Arc. | A | Arc. | A | Arc. | Arc. | Arc. |
| Cadillac | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | ... | ... |
| " (8 cyl) | ... | ... | ... | ... | ... | ... | ... | ... | Arc. | Arc. |
| Cartercar | A | E | A | E | A | E | Arc. | Arc. | Arc. | Arc. |
| " Com'l | A | Arc. | A | Arc. | A | Arc. | ... | ... | ... | ... |
| Case | A | A | A | Arc. | A | Arc. | A | Arc. | A | Arc. |
| Chalmers | A | Arc. | Arc. | Arc. | Arc. | Arc. | A | A | Arc. | Arc. |
| Chandler | ... | ... | ... | ... | ... | ... | Arc. | Arc. | Arc. | Arc. |
| Chase (air) | B | B | B | B | B | B | B | B | B | B |
| " (water) | ... | ... | ... | ... | ... | ... | Arc. | Arc. | Arc. | Arc. |
| Chesterfield six | ... | ... | ... | ... | ... | ... | ... | ... | A | Arc. |
| Chevrolet | ... | ... | ... | ... | A | A | A | Arc. | Arc. | Arc. |
| Cole | A | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. |
| Cunningham | A | A | A | A | A | A | Arc. | Arc. | Arc. | Arc. |
| Delaunay-Belleville | B | A | B | A | B | A | B | A | ... | ... |
| Detroiter | ... | ... | A | Arc. | A | Arc. | A | A | A | Arc. |
| " (8 cyl) | ... | ... | ... | ... | ... | ... | ... | ... | Arc. | Arc. |
| Dodge | ... | ... | ... | ... | ... | ... | ... | ... | E | E |
| E. M. F. | Arc. | Arc. | Arc. | Arc. | ... | ... | ... | ... | ... | ... |
| Empire | A | Arc. | A | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. |
| Fiat | B | A | A | A | B | A | B | A | B | A |
| Flanders | E | E | Arc. | Arc. | ... | ... | ... | ... | ... | ... |
| " (6 cyl.) | ... | ... | ... | ... | Arc. | Arc. | ... | ... | ... | ... |
| Ford | E | E | E | E | E | E | E | E | E | E |
| Franklin | A | Arc. | A | Arc. | A | Arc. | A | A | A | A |
| " Com'l | B | A | A | Arc. | A | Arc. | ... | ... | ... | ... |
| Garford | A | E | Arc. | Arc. | Arc. | Arc. | ... | ... | ... | ... |
| " Com'l | A | Arc. | Arc. | Arc. | Arc. | Arc. | A | A | ... | ... |
| Grant | ... | ... | ... | ... | ... | ... | Arc. | Arc. | Arc. | Arc. |
| Havers | A | Arc. | A | Arc. | A | Arc. | A | A | ... | ... |
| " (Model 6-60) | ... | ... | ... | ... | ... | ... | Arc. | Arc. | ... | ... |
| Haynes | A | Arc. | A | Arc. | A | Arc. | A | Arc. | A | Arc. |
| Hudson | A | Arc. | A | Arc. | A | Arc. | Arc. | Arc. | Arc. | Arc. |
| Hupmobile | ... | ... | ... | ... | A | Arc. | A | Arc. | A | Arc. |
| " (Model 20) | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | ... | ... | ... | ... |
| I. H. C. (air) | ... | ... | ... | ... | B | A | B | A | B | A |
| " (water) | ... | ... | ... | ... | A | A | A | A | A | A |

# Mobiloils

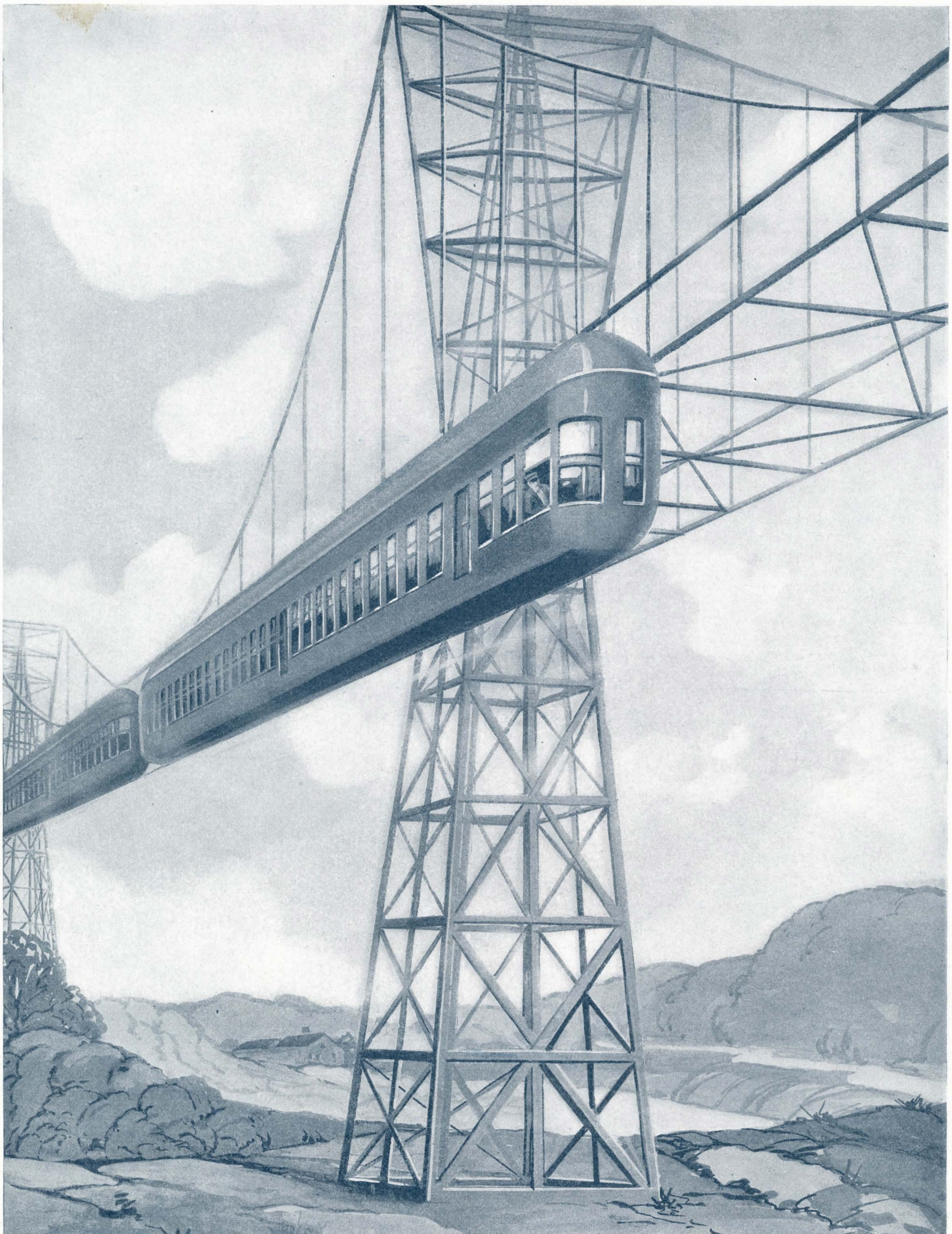
*A grade for each type of motor*

| MODEL OF | 1911 | | 1912 | | 1913 | | 1914 | | 1915 | |
|---|---|---|---|---|---|---|---|---|---|---|
| CARS | Summer | Winter | Summer | Winter | Summer | Winter | Summer | Winter | Summer | Winter |
| International | B | B | B | A | ... | ... | ... | ... | ... | ... |
| Interstate | A | Arc. | A | Arc. | A | Arc. | ... | ... | ... | ... |
| Jackson | A | Arc. | A | Arc. | A | Arc. | Arc. | Arc. | Arc. | Arc. |
| Jeffery | ... | ... | ... | ... | ... | ... | A | A | A | Arc. |
| " Com'l | ... | ... | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | A | Arc. |
| Kelly Springfield | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | A | A | A | A |
| King | A | E | A | E | A | E | A | A | A | Arc. |
| " (8 cyl) | ... | ... | ... | ... | ... | ... | ... | ... | Arc. | Arc. |
| " Com'l | ... | ... | ... | ... | ... | ... | Arc. | Arc. | Arc. | Arc. |
| Kissel Kar | A | Arc. | A | Arc. | A | Arc. | A | Arc. | A | Arc. |
| " " Com'l | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | A | Arc. | A | Arc. |
| " " (Model 48) | ... | ... | ... | ... | ... | ... | A | A | A | A |
| Kline Kar | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | A | Arc. | A | Arc. |
| Knox | B | A | B | A | B | A | B | A | B | A |
| Krit | A | A. | A | A | A | A | A | A | A | Arc. |
| Lippard Stewart | ... | ... | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. |
| Locomobile | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | E | E | E | E |
| Lozier | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | A | Arc. | ... | ... |
| Lyons Knight | ... | ... | ... | ... | ... | ... | A | A | B | A |
| Mack | A | E | E | E | E | E | A | E | A | E |
| " (Model S) | ... | ... | ... | ... | A | A | A | A | A | A |
| Marion | A | E | A | Arc. | A | Arc. | Arc. | Arc. | Arc. | Arc. |
| Marmon | A | Arc. | A | Arc. | A | Arc. | A | Arc. | A | Arc. |
| Maxwell | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. |

| MODEL OF | 1911 | | 1912 | | 1913 | | 1914 | | 1915 | |
|---|---|---|---|---|---|---|---|---|---|---|
| CARS | Summer | Winter | Summer | Winter | Summer | Winter | Summer | Winter | Summer | Winter |
| Mercer | A | Arc. | A | Arc. | A | Arc. | A | Arc. | A | Arc. |
| " (22-70 Series) | ... | ... | ... | ... | ... | ... | ... | ... | Arc. | Arc. |
| Metz | B | Arc. | A | Arc. | A | Arc. | A | Arc. | A | Arc. |
| Mitchell | A | Arc. | A | Arc. | A | Arc. | A | Arc. | A | Arc. |
| Moline | A | Arc. | A | Arc. | A | Arc. | ... | ... | ... | ... |
| " Knight | ... | ... | ... | ... | ... | ... | A | A | A | A |
| Moon (4 cyl.) | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | A | Arc. | Arc. | Arc. |
| " (6 cyl.) | ... | ... | ... | ... | ... | ... | Arc. | Arc. | Arc. | Arc. |
| National | A | A | A | A | A | A | A | A | A | Arc. |
| Oakland | A | Arc. | A | Arc. | A | Arc. | Arc. | Arc. | Arc. | Arc. |
| Oldsmobile | A | Arc. | A | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. |
| Overland | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. |
| Packard | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | A | Arc. | A | Arc. |
| Paige | A | Arc. | A | E | A | E | A | A | A | Arc. |
| " (6 cyl) | ... | ... | ... | ... | ... | ... | ... | ... | Arc. | Arc. |
| Pathfinder | ... | ... | ... | ... | A | Arc. | Arc. | Arc. | Arc. | Arc. |
| Peerless | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. |
| Pierce Arrow | A | Arc. | A | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. |
| " " Com'l | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. |
| Pope Hartford | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | ... | ... |
| Premier | A | Arc. | A | Arc. | A | Arc. | A | Arc. | A | Arc. |
| Rambler | A | Arc. | Arc. | Arc. | Arc. | Arc. | ... | ... | ... | ... |
| Regal | A | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. |
| Renault | A | Arc. | A | Arc. | A | Arc. | A | Arc. | ... | ... |
| Reo | A | Arc. | A | Arc. | A | Arc. | A | Arc. | A | Arc. |
| S. G. V. | B | Arc. | B | Arc. | B | Arc. | A | Arc. | A | Arc. |
| Saurer | A | Arc. | A | Arc. | A | Arc. | Arc. | Arc. | Arc. | Arc. |
| Saxon | ... | ... | ... | ... | ... | ... | E | E | E | E |
| Selden | A | E | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. |
| Simplex | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. |
| Speedwell | A | Arc. | A | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. |
| " Mead | ... | ... | ... | ... | A | Arc. | B | A | B | A |
| Stearns | A | Arc. | A | Arc. | ... | ... | ... | ... | ... | ... |
| " Knight | ... | ... | A | A | A | A | B | A | B | A |
| " " (Light 4) | ... | ... | ... | ... | ... | ... | ... | ... | A | Arc. |
| Stevens Duryea | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. |
| Stoddard-Dayton | A | A | A | A | A | A | ... | ... | ... | ... |
| " " Knight | ... | ... | A | A | A | A | ... | ... | ... | ... |
| Studebaker | A | Arc. | Arc. | Arc. | A | Arc. | A | Arc. | Arc. | Arc. |
| Stutz | ... | ... | Arc. | Arc. | Arc. | Arc. | A | A | A | A |
| Velie (4 cyl.) | A | Arc. | A | Arc. | A | Arc. | A | Arc. | A | Arc. |
| " (6 cyl.) | ... | ... | ... | ... | ... | ... | Arc. | Arc. | Arc. | Arc. |
| Walter | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | A | A |
| White | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. |
| Willys Knight | ... | ... | ... | ... | ... | ... | A | A | B | A |
| " Utility | ... | ... | ... | ... | ... | ... | A | Arc. | Arc. | Arc. |
| Winton | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. |


FATIMA
THE TURKISH BLEND CIGARETTE
Men like Fatima-like the good tobacco–like the blend–a "distinctively individual" character that pleases the whole country!
Liggett & Myers Tobacco Co.
20 for 15¢
FATIMA
TURKISH BLEND CIGARETTES
Cameron & Cameron Co.
RICHMOND, VA.
LIGGETT & MYERS TOBACCO CO. SUCCESSOR.
NO GOLD TIPS BUT FINEST QUALITY

SCIENTIFIC AMERICAN



A FAST MONORAIL TRAIN CROSSING A VALLEY.—[See page 292.]

Vol. CXII. No. 13
March 27, 1915

Munn & Co., Inc., Publishers
New York, N. Y.

Price 10 Cents
$3.00 A Year


BUILT IN truck service as rendered by The White Company proves *character of construction* and insures *maximum hauling.*

*Pre-purchase* service given by White analysts enables the buyer to avoid mistakes in selecting the truck for his particular needs.

Such service advantages—at the time a choice is made and thereafter in the highest measure of efficiency—are far beyond any service which means only quick repairs.

The number and size of White fleets is your guaranty that such service is *delivered*—according to promise. The growth of White fleets is evidence of satisfaction—for only the satisfied man buys the same thing again and again.

***You are invited to submit your transportation problems to us. We can help you.***

*Exhibiting at the Transportation Building, Panama-Pacific International Exposition, San Francisco*

THE WHITE COMPANY
CLEVELAND
LARGEST MANUFACTURERS OF COMMERCIAL MOTOR VEHICLES IN AMERICA

| | |
|---|---|
| **New York** | **Broadway at 62nd Street** |
| **Chicago** | **2635-2645 Wabash Avenue** |
| **Philadelphia** | **216-220 North Broad Street** |
| **Boston** | **930 Commonwealth Avenue** |
| **San Francisco** | **Market Street and Van Ness Ave.** |
| **Baltimore** | **Mt. Royal and Guilford Avenues** |
| **Pittsburgh** | **Craig Street and Baum Boulevard** |
| **Atlanta** | **63-65 Ivy Street** |
| **St. Louis** | **3422 Lindell Boulevard** |
| **Washington** | **1233 20th Street, N.W.** |
| **New Orleans** | **750 St. Charles Avenue** |
| **Newark** | **33-35 William Street** |
| **Seattle** | **1514 Third Avenue** |
| **Memphis** | **278-280 Monroe Avenue** |
| **Dallas** | **2025-2027 Commerce Street** |
| **Toronto** | **14 Alexander Street** |
| **Montreal** | **Forum Building** |
| **Winnipeg** | **230 Fort Street** |

SEVENTY-FIRST YEAR

# SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

VOLUME CXII. NUMBER 13. | NEW YORK, MARCH 27, 1915 | 10 CENTS A COPY $3.00 A YEAR

## Rescue Company No. 1 of the New York Fire Department

THERE is nothing a fireman dreads so much as a smoky fire, and when that smoke contains choking fumes and poisonous gases his task is hazardous in the extreme. Nevertheless he must penetrate that smoke to its source, regardless of personal danger. Time and time again have the firemen of New York city risked their lives in fires of this kind, bravely rushing into veritable death traps, struggling until overcome, then being dragged out in the nick of time by their companions; and sometimes they have not been dragged out in time.

Although such conditions have existed for a long time, and the work of mine rescue squads has pointed out the value of smoke helmets in just such conditions, it was not until after the subway fire last January that any definite action was taken. At that time, it will be recalled, hundreds of passengers stalled in the subway were overcome by the fumes of burning insulation, and the firemen had no end of difficulty in dragging them out. The SCIENTIFIC AMERICAN then pointed out the urgency of having a rescue squad of firemen equipped with smoke helmets. Immediately after the fire, with commendable promptness, such a company was organized.

Tests were made of six or seven varieties of smoke helmets in order to determine the best for firemen's use. Finally the one shown in the accompanying illustrations was adopted with a slight modification at a point which was thought to show a slight weakness, and ten helmets of this type were bought. The manufacturers claimed that this helmet with its oxygen tank and regenerator would keep a man supplied with fresh oxygen at the rate of two liters (about two quarts) per minute for an hour. At the end of that time a gage, known as the "finimeter," would register zero, but there would be still enough oxygen in the tank to keep a man supplied at the same rate for twenty minutes more. In order to make sure of this, Capt. John J. McElligott, in charge of the rescue company, decided to try out the helmet under extreme conditions. At the Firemen's College there is a concrete room, twenty feet square, where sprinklers are tested. Into this room a quantity of smoke-making fuel was put, consisting of excelsior, straw, oakum, rubbish of all kinds, and sulphur. This was set afire and it produced dense volumes of smoke and intense heat. Into this inferno Capt. McElligott went equipped with his smoke helmet, and the door was closed behind him. The firemen found it difficult to close the door at first because of the outflow produced by expansion of the air in the room. The helmet was equipped with a telephone, by which Capt. McElligott could communicate with the outside. He had with him a thermometer registering up to 500 degrees, and he found that the temperature rose quickly to 280 deg. Fahr. Despite this intense heat, he remained in the room watching the index pointer of the finimeter gradually swing down to zero, when his watch showed him that he had been in an hour, and then he remained fifteen minutes more—seventy-five minutes altogether in a temperature which, for at least three quarters of an hour, was up to 280 deg. Fahr. At the end of that time he emerged thoroughly exhausted, streaming perspiration, with the sweat slushing in his shoes at every step. His clothes were rotted by the action of the fumes, and his hands were so blackened that it was impossible to wash them white again. The discoloration did not wear off for weeks.

The air regenerating apparatus.

It is astonishing what an intense heat one is able to stand in dry air. Water at a temperature of 150 degrees would scald a person. In a Turkish bath the temperature may go up to 200 degrees. But 80 degrees above that is decidedly uncomfortable, to say the least, and it is really remarkable that anyone should have been able to stand it for an hour and a quarter. Capt. McElligott states that it was very distressing, but that he experienced no scalding effect except at one time when a drop of water, which evidently had condensed upon the ceiling, splashed down on the leather flap of his helmet and burned right through to his neck.

This kind of helmet apparatus has been described in the SCIENTIFIC AMERICAN before, but a brief explanation of its operation may not be amiss. From the helmet there are two tubes leading down to a pair of "breathing bags" that rest on the breast of the wearer. One of these bags takes the surplus inspiratory air and the other the surplus expiratory air. The air that is exhaled passes from the breathing bag to the back of the wearer, where it is forced through a regenerator consisting of a receptacle containing caustic potash. The caustic potash removes the carbon dioxide. The regenerator is shown at the left in the rear view of the apparatus. At the right is the tank in which oxygen is kept at a pressure of about 1,800 pounds per square inch. This passes through a reducing valve so that it will flow out at the rate of two liters per minute, and passing through an injector serves to force the exhaled air through the regenerator. As some heat is produced in the regenerator, the air mixed with fresh oxygen passes through a cooler before making its way to the inspiratory breathing bag. Thence it is inhaled through the tube shown at the left hand in the front view of the helmets. In order to make an effective seal of the helmet, it is provided with a soft rubber tube which is inflated to fit snugly around the face, and this is pumped up by means of the small bulb pump which may be seen hanging from the face plate of the helmet. On the opposite side of the face plate is a small projection, which is the handle of a sponge mop with which the fireman may wipe the perspiration out of his eyes or brush away any irritation. This is a feature that is very much appreciated. Divers who have no such means of relieving itching or irritations of the face, frequently suffer untold agony.

For nearly two months eight men besides Capt. McElligott and his lieutenant have been practising with this apparatus and also with pulmotors and a Blaugas-oxygen torch, and on March 8th they were established as Rescue Company No. 1. They have a motorcar fitted with the Blaugas torch apparatus, two pulmotors, stretchers, smoke helmets, and additional cylinders of oxygen for the pulmotors and the helmets, besides the customary life-gun, fire-extinguishers, axes, etc. They respond to every two-alarm fire south of Fifty-ninth Street and to three-alarm fires as far as 125th Street. Already they have shown themselves invaluable. At a recent fire in a building extending from Greene to Mercer streets, the fire was at one end of the building and the entrance at the other. This meant that the firemen would have to grope through two hundred feet of black smoke before reaching the fire. Ordinarily this would have meant the suffocation of many of the men, but the helmeted men went to the front without the slightest difficulty and located the blaze.

As yet the torch has not been put to any service, but it is provided for occasions where armored doors are encountered which resist the battering of axes. With the torch the locks can be cut out with practically no delay. In a test of this apparatus a bar of steel four inches square, in cross-section, was cut through in 63 seconds. The apparatus carried by the company has a capacity of fifty-six 1-inch cuts. It will be recalled that when the Equitable Building burned down a number of men were trapped in the basement behind windows guarded by thick iron bars. The firemen exerted almost superhuman efforts in endeavoring to cut through those bars. Had the Rescue Company been in existence then, the bars could have been burned through in a couple of minutes and the men easily saved.

Members of the first rescue company of the New York Fire Department.

# SCIENTIFIC AMERICAN

**Founded 1845**

**NEW YORK, SATURDAY, MARCH 27, 1915**

Published by Munn & Co., Incorporated. Charles Allen Munn. President; Frederick Converse Beach, Secretary
Orson D. Munn, Treasurer
all at 361 Broadway, New York

Entered at the Post Office of New York, N. Y., as Second Class Matter
Entered as Second Class Matter at the Post Office Department, Canada.

Trade Mark Registered in the United States Patent Office




**Subscription Rates**

| | |
|---|---|
| Subscription one year ... Postage prepaid in United States and possessions. Mexico, Cuba, and Panama | $3.00 |
| Subscriptions for Foreign Countries, one year, postage prepaid, | 4.50 |
| Subscriptions for Canada, one year, postage prepaid ... | 3.75 |

**The Scientific American Publications**

| | |
|---|---|
| Scientific American (established 1845) ... per year. | $3.00 |
| Scientific American Supplement established 1876. " " | 5.00 |
| American Homes and Gardens ... " " | 3.00 |

The combined subscription rates and rates to foreign countries including Canada, will be furnished upon application.
Remit by postal or express money order, bank draft or check

**Munn & Co., Inc., 361 Broadway, New York**

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp* the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.


*The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.*

## A Fair Field and No Favor

THE failure of the Shipping Bill has served the purpose of clearing the atmosphere of some of the fog which has covered the whole question of the American merchant marine, and to that extent the attempt to pass this bill, involving as it did a lengthy and very thorough discussion of the question in all its bearings, has been profitable and in many ways helpful. The policy of the straight subsidy has been subjected in previous years to a similar thorough thrashing out, both inside of Congress and outside; its fallacies have been exposed; the whole country has been given an opportunity to express its wishes in the matter; and it is now certain that the question of subsidy is dead for all time. Another proposed panacea, from which much has been expected, namely, the imposition of preferential duties, has been rejected. The restriction upon the purchase and operation under our flag of foreign-built ships has been removed; and while some advantage has resulted from this measure, the benefit has proved to be so limited as to leave the problem pretty much where it was. Hence, it must be admitted that the endless discussion and the attempted legislation for the merchant marine have served a good purpose in so far as they have cleared the air and brought both Congress and the nation a measurable step nearer to the true solution of the problem.

The causes which render the construction and operation of the American-built ships unprofitable are twofold. First, it costs more to build a ship in our yards than it does in foreign yards, and secondly, because of certain burdensome navigation laws, it costs a great deal more to operate them.

The first difficulty should be met by doing everything possible in the way of legitimate legislation to remove the handicap under which our shipbuilders labor; and to this end it would be advisable to permit the importation free of duty of all materials which enter into the construction of ships built for the American merchant marine. A few years ago, and for aught we know, to-day, the plate mills of this country were selling ship plates at a lower cost in Great Britain than they could be bought by our own American yards. It would be a far-sighted policy on the part of our steel mills, if, in the endeavor to encourage American shipbuilding, they made it a point to lay down ship plates in American yards, at least at the same price as they are delivered to foreign shipbuilders. If this were done, and all the materials that enter into the construction of a ship were permitted to enter this country free of duty, the materials cost would be considerably lowered and our shipbuilding yards, in spite of their heavy labor costs, would, by their excellent system of management and the super-excellence of their plant, be in a position to build, if not as cheaply, at least very closely to the price at which tonnage is turned out in foreign yards.

The principal burden under which our mercantile marine labors, however, is the much greater cost of operation. This is due to certain antiquated and very burdensome laws with respect to the employment of seamen, their accommodations, food, and the various regulations governing their employment. As long as this burden exists, our merchant marine will be heavily handicapped in competition with the deep-sea shipping of the world. If Congress, instead of wasting its time in trying to pass laws which like the defunct Shipping Bill are opposed to the most elementary economic principles, would set itself seriously to consider a revision of our navigation laws and the removal of the burden under which our deep-sea trade is carried on, we believe that private capital would be encouraged to enter generously upon the task of building up a great merchant marine. Before many years we should be in a position to carry our own goods in our own bottoms and retain the $300,000,000 annually which is now paid to foreign shipowners.

Legislation of this character would be well directed. It would receive the endorsement not only of the shipping interests but of the vast majority of the people of the country. There is not a practical shipping man in the United States to-day who does not believe that, if thereby Congress gave our merchant marine an opportunity to demonstrate what it could do in a fair field with no favor, it would ultimately regain the proud position which it held in the middle decades of the last century.

## The Chemist as a "Trust Buster"

IN the last report of the Bureau of Mines, Director Holmes made a stirring appeal for Government aid in behalf of industrial research. He pointed out that the Department of Agriculture spent about as much for printing and binding alone as the Bureau of Mines for research, and this despite the fact that untold millions could be added to the country's wealth if the Government scientists were given the opportunity. Although he did not say so, he probably despaired of interesting our populistic congressmen in his plans, apparently because farmers, having votes, may ask Congress for anything and obtain it, and because mines are owned by capitalists who are not in high favor just now. Being a mere scientist he did not understand how these problems should be attacked. Instead of talking economics and conservation he should have talked "trusts" and "oppression."

The Secretary of the Interior understands these things better. A scientific man would never dream of converting a chemical discovery into political capital. Now that the Secretary has shown how the Rittman process of increasing the yield of gasoline may become a means of thwarting the deviltry of Standard Oil, he will know how a chemical formula may be miraculously transformed into a battle cry of freedom from trust control, how politics and science may be united, and how the millions we need for research may be obtained.

Back of Secretary Lane's public announcement lurks the spirit of antagonism against large corporations that has animated the present Administration. We had thought that the fangs of the Standard Oil had been drawn long ago and that it had been reduced to thirty-three harmless parts. We had thought that the only marked development in petroleum refining of recent years—the Burton process of cracking—was a development of the Standard Oil Company of Indiana alone. In the face of the well-known "state of the art," as patent lawyers term it, Secretary Lane makes the absurd statement that "for some time the Standard Oil Company through the great amount of money at its command, through its employment of expert chemists, and through its extensive organization, has had a big advantage over the independents in the production of gasoline, this company having a patented process that obtains for it as much as three times the amount of gasoline from a given quantity of petroleum as the independents now obtain." This, we presume, is a veiled reference to the Burton process, which, we repeat, was developed by the Standard Oil Company of Indiana alone. "There are two or three other large corporations," continues Secretary Lane, "that have an efficient process for the manufacture of gasoline, but the independents as a whole have never been able to approach the results obtained by the Standard Oil Company. Now the Federal Government, through the efforts of Dr. Rittman, proposes to make free, for the use of all of the people of this country who wish it, a process that is confidently expected to increase their yields of gasoline from crude petroleum fully 200 per cent and perhaps more."

The publicity methods which have been adopted by Secretary Lane must be offensive to every real scientific man. Dr. Rittman's process is still in the laboratory stage. It is contrary to the unwritten code of scientific ethics to exploit an undeveloped invention in this cheap promoter fashion. When it is considered that many thousands of dollars must still be expended to ascertain whether or not laboratory success can be duplicated on a factory basis and that much ingenuity must be exercised in devising pressure retorts which will work day in and day out with the regularity demanded by a commercial enterprise, the Secretary's announcement must be considered as reckless. There are oil refiners enough in the United States of America who would gladly have conducted experiments on a sufficiently large scale to ascertain just what we may expect of Dr. Rittman's investigations; but until those experiments had been made it was wrong to mislead the public by rushing into print.

If the Secretary's statement had been more guarded and accurate, even its premature publication might have been overlooked. As it stands, it presents an absurd picture of the control supposedly exercised by the Standard Oil Company on the development of the petroleum industry on its scientific side and of the miracles that are to be achieved in building up a coal tar chemical industry comparable with that of Germany. Let anyone read the paper by Brooks, Bacon, Padgett, and Humphrey in the March number of the *Journal of Industrial and Engineering Chemistry* and he will learn what the state of the petroleum refining art really is and how much has been contributed to our knowledge of "cracking" distillates by English, French, German, and Russian chemists. Anyone can take the old Dewar and Redwood process, upon which even the Burton is only an improvement, and work it with success.

Chemists will be even more amused by Secretary Lane's conception of a coal tar dye industry founded on the basis of Dr. Rittman's undeveloped laboratory discoveries. Anyone who has read Dr. Bernhard C. Hesse's analysis of the coal tar dye industry of Germany, made for the General Chemical Company, must be convinced that even if the Rittman process be carried to the most brilliant commercial success, we must have something more than cheap raw material with which to make synthetic drugs and dyes. There must be co-operation between the dye user and the dye maker. The manufacture of coal tar chemicals is an economic rather than a technical problem. Hundreds of intermediate products must be handled in a way that is distinctly forbidden by our anti-trust laws. We have a small coal tar chemical industry now, but it can never grow to the proportions of the German trust-controlled industry merely because the Rittman process may give us cheap benzol. If there is any doubt about this, consider the following from the "Recommendations of the New York Section of the American Chemical Society on the Enlargement of the Coal Tar Chemical Industry in the United States":

> Benzol, toluol and the like are produced in sufficient amount in present installations of by-product coke-ovens to provide all of the things that would be needed for a coal-tar chemical industry of a magnitude sufficient to supply the United States market; the separation of these materials from the gas that carries them is dependent upon the market and the demand therefor. There is no inherent defect in our coke-industry with regard to the actual making of these things; the only question involved is whether it be more profitable to burn the benzol, toluol and the like contained in the gas as a fuel than to separate them from the gas and from each other for purposes of sale. Ample supply can be provided before any plant that could use benzol and the like for dyestuff making could be erected in the United States, and thereafter the supply of these materials can readily be kept up to any requirement.

After that one has a feeling that Germany may continue to sing: "Lieb Vaterland magst ruhig sein."

## Scientific Research in the Public Health Service

ONE result of the national health insurance law recently put in operation in Great Britain is that the British government is now making a liberal annual expenditure for medical research. The law provides that a definite portion of the funds contributed by Parliament to the insurance scheme shall be spent in research, and this amounted in 1914 to the respectable sum of £56,000.

It is an interesting coincidence that the United States Government has also quite recently placed its work in medical research on a firm footing by materially enlarging the scope and resources of the Public Health Service. A law enacted August 14th, 1912, contained broad authorization for investigations of "the diseases of man and conditions influencing the propagation and spread thereof, including sanitation and sewage and the pollution, either directly or indirectly, of the navigable streams and lakes of the United States," and a year later an appropriation of $200,000 was made for field investigations under this authorization. Additional funds were authorized for enlarging the work of the Hygienic Laboratory and for other incidental purposes connected with research.

According to the annual report of the service recently issued, the last fiscal year marks the beginning of a new epoch in the development of medical research by the Government. The summary of the work done in this direction by the service runs to 117 octavo pages, and is a remarkable record of beneficent activity.

Among the diseases of man investigated in the Government laboratories and hospitals and in the field were beriberi, diphtheria, endemic goitre, hookworm disease, leprosy, typhoid fever, malaria, pellagra, trachoma, tuberculosis, typhus fever, and various occupational diseases. These studies also entailed the investigation of sanitary conditions; systematic studies were made of rural sanitation, school hygiene, industrial hygiene, and health organization and administration. Lastly, investigations were made on the pollution of rivers and coastal waters, the disposal of sewage, and the treatment of industrial wastes. These undertakings entailed a large increase in the research staff of the service.

## Notes on the War

**Aftermath of the North Sea Fight.**—Probably, when the history of the North Sea fight between battle-cruisers is written, it will be found that the 29-knot "Lion," "Tiger" and "Princess Royal" were opposed to the "Doerflinger," "Seydlitz" and "Moltke" of about the same speed, and that the "Indomitable" and "New Zealand" of 26½ and 27 knots were outdistanced. If so, after the disablement of the "Lion" and her withdrawal, the three German battle-cruisers possessed a heavy preponderance of armor-piercing guns over the "Tiger" and "Princess Royal," opposing as they did twenty-eight 11- and 12-inch guns to sixteen 13.5-inch. As we showed in a recent article, the German guns outranged the British, and, in view of their heavier gun fire, the fact that the Germans even then continued their flight suggests that the Admiralty had given orders to avoid an engagement and save the ships for the big fleet engagement, should it ever come off.

**Two Hundred Miles of Trenches on 12-mile Front.**—A correspondent of the New York *Times*, describing a trip along the line of the French, British and Belgian forces, speaks of visiting a stretch of fighting front 12 miles in length, on which the line was so irregular and so intricate, that the total length of the successive trenches with their zigzag approaches, etc., was 200 miles. Although this seems to be an exaggerated estimate, it is by no means impossible under the conditions of French warfare as being now carried out on the eastern front. Where the advance is made by yards at a time, and captured trenches are added to those of the successful advance, it is quite possible that from the foremost line facing the enemy, back to the rearmost trenches of the attacking force, the total length, if the zigzag approaches are taken into account, might well reach the high figure quoted. This will be understood if a study has been made of the modern system of entrenchment, as shown in our issues of October 3d and December 5th, 1914.

**A Demand for 16-inch Coast-defense Guns.**—Before the "Queen Elizabeth" had done her surprising work in reducing the Dardanelles forts at 21,000 yards range, Brigadier-General E. N. Weaver, Chief of Coast Artillery, had recommended the construction of 16-inch 50-caliber guns for the new fortifications at the entrance to the Chesapeake Bay. Such a piece would be superior to the 15-inch naval guns on every point of comparison. The Elswick 15-inch naval gun fires a 1,925 pound shell with a muzzle velocity of 2,500 feet per second and a muzzle energy of 83,425 foot tons. A coast defense 50-caliber 16-inch piece, firing a 2,500 pound shell with equal velocity, would have a muzzle energy of well over 100,000 foot tons; moreover, because of the high degree of elevation which could be given, it would greatly outrange the 15-inch gun. In view of the extraordinary increase in fighting ranges developed during the war, it will be good policy to mount some 16-inch guns at all our existing defenses, and particularly at Panama, and in the Philippines.

**Obsolescent Battleships to the Fore.**—Very interesting is the fact that the bulk of the battleships which are engaged in reducing the forts of the Dardanelles are ships whose term of usefulness was supposed to be near its end. That estimate, however, was based upon their ability to stand the test of battle on the high seas, in which work, if matched against modern ships, they would be worse than useless. For the particular duty assigned them in the Dardanelles, namely, that of silencing the guns of small caliber and limited range after the heavier guns of from 9.4- to 14-inch caliber have been dismounted by such ships as the "Queen Elizabeth," the "Nelson" and the "Agamemnon," they are admirably suited. Their 10- and 12-inch shells carrying large charges of high explosives have proved to be terribly destructive in wrecking gun positions, blowing up magazines, etc. Their armor of from 12 to 16 inches in thickness and the possession of the heavy protective decks, which were given to ships from 15 to 20 years ago, enabled them to withstand the attack of 5- and 6-inch shells with comparative immunity.

**Eight Russian Dreadnoughts Approaching Completion.**—An important fact affecting the naval situation in the Baltic, of which little public mention has been made, is that the Russian fleet in those waters will shortly be augmented by the addition of eight new dreadnoughts of great size and power, which are nearing completion and will probably go into commission during the present year. Four of these ships, the "Sebastopol," "Petropavlovsk," "Poltava" and "Gangut," are dreadnoughts of 23,026 tons displacement, 23 knots speed, carrying each twelve 12-inch guns and sixteen 4.7-inch guns. They were launched between June and October, 1911, and work upon them having been accelerated, they should be in commission before many months have passed. The other four will be the largest battle-cruisers afloat. They are named the "Ismalia," "Kinburn," "Borodino" and "Navareno." The displacement of these ships is 32,200 tons, the speed 28 knots, and each of them will carry the enormous battery for a battle-cruiser of twelve 14-inch guns and twenty-one 5.1-inch guns.

## Science

**Vulcanological Studies in the West Indies.**—Dr. E. O. Hovey has been sent by the American Museum of Natural History to the West Indies to continue the vulcanological investigations that he began in that region after the great eruption that destroyed St. Pierre. He expects to spend about three months in studying, especially, the Grande Soufrière of Guadeloupe, Mont Pelé, the Soufrière of St. Vincent, and the boiling lake of Dominica, collecting gases from the fumeroles, making temperature observations, and noting the changes that have occurred since his last visit.

**Concentrated Cider and Cider Syrup.**—These two new products of surplus and cull apples are described in the last annual report of the U. S. Bureau of Chemistry. In manufacturing the former the apple juice is frozen solid and the block of ice is crushed and placed in a centrifugal machine, which removes the concentrated cider, leaving the ice behind. The product, when diluted with water, has practically the flavor and qualities of the original apple juice. The concentrated cider ferments very slowly at refrigerator temperatures, but at room temperatures ferments in a few weeks. It is, of course, much cheaper to transport than ordinary cider. Cider syrup is made by clarifying and boiling down apple juice, and it is said to be of value for table use.

**The Auto-irrigator.**—This is a new instrument for measuring the water-attracting power of the soil, devised in connection with experiments by Prof. B. E. Livingston and Dr. L. A. Hawkins at Johns Hopkins University. It is essentially similar to Livingston's porous-cup atmometer, but the cup is buried in the soil instead of being exposed to the air. The experimenters have carried out a series of measurements upon potted plants irrigated automatically with this device. The rate of water-loss from the irrigator is found to be highest somewhat later in the day than the time of maximum transpiration from the plants. The rate of loss from the irrigator then falls slowly, reaching its minimum in the early morning.

**Effects of Grass on Trees.**—This subject was brought into prominence a few years ago by the researches of S. U. Pickering, of the Woburn Experimental Fruit Farm, in England. We have previously noted in these columns his observations concerning the very injurious influences of grass on orchard trees, apparently due to some toxic substance produced by the former. The question has now been taken up at another English research institution; viz., the Long Ashton station of the University of Bristol. Mr. Barker also finds that grass seriously impairs tree growth, but the effect is less marked in land which is grassed at the time the trees are planted and remains so than in land which is first cultivated and subsequently grasses. In other words, trees are able to acquire some degree of immunity from the toxic effect in question.

**Salton Sea** fell 42 inches during the year ending June, 1914, when the annual sample of its water was collected for analysis by the Carnegie Department of Botanical Research. The annual concentration of the water is about 18 per cent. During the year in question the total solids increased from 1,003 to 1,180 parts per 100,000. During 1914 the Carnegie botanists also made a collection of the algæ growing in Salton Sea, with a view to determining whether these plants are responsible for deposits of tufa, as has recently been suggested by Jones and Walcott. Similar investigations have been made in the Lake Lahontan basin, where remnants of algæ have been found in all the tufas except the thinolitic form. Laboratory experiments on the subject are in progress.

**Biological Relations of Atmospheric Ionization.**—Some recent studies of H. A. Spoehr indicate that sunlight and ultra-violet light, in addition to their direct physical and chemical influence on important plant processes, also affect these processes indirectly by affecting the air surrounding the plant. The effect is especially noticeable in the respiratory activity. Experiments were carried out in which the only variable factor to which plants were exposed was the air of day on the one hand and of night on the other. Air drawn from out-of-doors was freed from its carbon dioxide by means of coarse soda-lime, then drawn over the plants kept in the dark at constant conditions of temperature and humidity, and finally through a standard barium hydroxide solution in Meyer's tubes. The rate at which carbon dioxide was evolved by the plants was found to be regularly higher by day than by night. It was thought that this difference in respiratory activity might be due to variations in the chemical activity of the atmospheric oxygen as indicated by the values for atmospheric ionization, and this was tested by discharging the air by passing it between the poles of a series of electric batteries before it reached the plants. The differences in respiratory activity between day and night were found to be much reduced under these conditions. Without this deionizing process the course of the rate of carbon dioxide evolution showed a marked similarity with the values generally given for atmospheric ionization. Wheat seedlings were found most convenient for use in these experiments.

## Astronomy

**Rotation of Two Satellites of Saturn.**—Observations made at the Lowell Observatory on the varying brightness of two satellites of Saturn, viz., Mimas and Enceladus, indicate that these bodies rotate on their axes in periods identical with those of their revolution around the primary; i. e., they behave like our own moon, and probably like satellites generally.

**Copernicus Visible to the Naked Eye.**—The Swiss astronomer J. Pidoux reports in *Astronomische Nachrichten* that he was recently able, from an elevated spot near Geneva where the air was particularly pure, to distinguish plainly with the naked eye the lunar crater Copernicus, when lying beyond the terminator, i. e., the summit of the crater was illuminated while the surrounding region was still in shadow.

**The "Parsec."**—This convenient unit, suggested by Prof. Turner, and used by the astronomer-royal, Sir F. Dyson, in a recent discourse at the Royal Institution, has not yet been defined in any dictionary. It is the distance at which a star's parallax is one second of arc, or 206,265 times the distance of the earth from the sun. If the sun were at a distance of 1 parsec it would still be one of the brightest stars in our sky, with a magnitude of 0.5. If distant 100 parsecs its magnitude would be 10.5. Most of the stars within the range of our telescopes are believed to be within a distance of 1,000 parsecs.

**Remarkable Stellar Velocity.**—Recent observations at the Mount Wilson Observatory on the star O. Arg. S. 14,320 indicate that it has a remarkably rapid motion in space. It is a star of the 9.2 magnitude, having a carefully determined parallax of +0.035 second and a proper motion of 3.76 seconds annually. Its radial motion, as determined approximately with the spectrograph, is +290 kilometers (180 miles) per second. This gives for its actual velocity in space 577 kilometers (358 miles) per second, which far exceeds even that of the famous star Groombridge 1830. The average velocity of a star in space has been estimated at about 21 miles per second.

**The Magnetic Field of the Sun.**—Prof. Hale and his assistants have continued their fruitful investigations of this subject, and during the past year 25 spectrum lines, all originating at comparatively low levels in the solar atmosphere, have been found to show the Zeeman effect, and hence the existence of the sun's general magnetic field. The elements represented by these lines are iron (10 lines), chromium (8), nickel (4), vanadium (2), unidentified (1). The displacements due to the general field appear to be confined to the lower levels of the solar atmosphere, in harmony with previous observations on this subject. The measurements show that the vertical intensity of the general field at the poles varies from a value of 55 gausses for the weakest lines to 10 gausses for the strongest lines yet found to show the effect. A preliminary attempt to detect the Stark effect due to electric fields in sunspots has not thus far yielded any positive results.

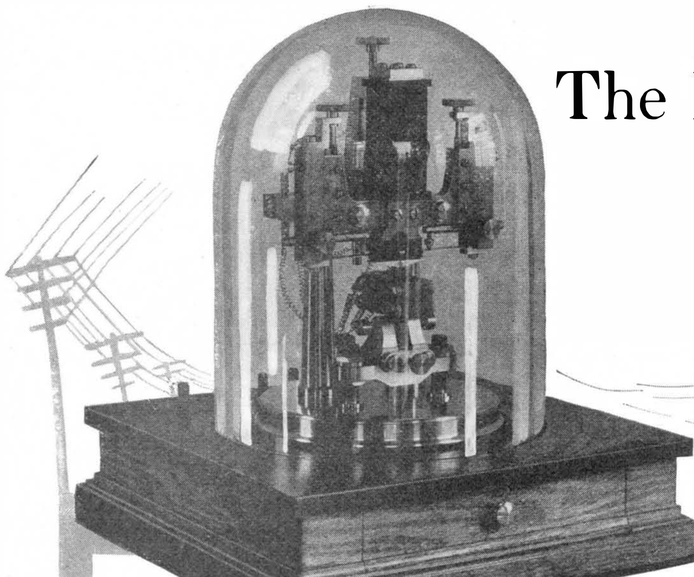
**The Stars of Napoleon.**—Camille Flammarion, writing in *L'Astronomie*, records with much gusto the fact that a German university once sought to curry favor with Napoleon by dedicating a group of stars to him. In 1807, when the French conqueror was at the summit of his power, the University of Leipzig issued a statement to the learned world setting forth the reasons which had led it "to consecrate to the glory of his majesty Napoleon the stars of the sword and the belt of Orion." These stars were not to constitute a new constellation, but an asterism in the constellation of Orion bearing the special name of "Stellae Napoleonis," just as a certain group of stars in Taurus bears the name of the Pleiades, and another the Hyades, etc. The academic announcement contained much fulsome praise of Napoleon, and pointed out the appropriateness of giving his name to a group of stars surmounting the constellation of Eridanus (the Po), the namesake of the terrestrial river near which Napoleon won his early victories.

**Mounting for the 100-inch Telescope.**—The last annual report of the Mount Wilson Observatory states that all the larger parts of the mounting for the 100-inch reflector (which will be much the largest telescope in the world) will probably be assembled at the Fore River shops, where they have been constructed, in time to permit shipment to Pasadena, *via* the Panama Canal, early this year. Meanwhile the smaller parts and accessories have been under construction at the observatory. The driving-clock, which is nearly completed, required more than half a ton of bronze castings and nearly 1½ tons of iron castings, in addition to the 2-ton driving weight. The circular steel building for this instrument is complete up to the rails which are to carry the dome. The latter has been built in Chicago and is about finished. The building and dome will probably be completed next summer so that the mounting may be set on the pier in the autumn. Meanwhile good progress has been made with the capital task of grinding and figuring the great mirror.

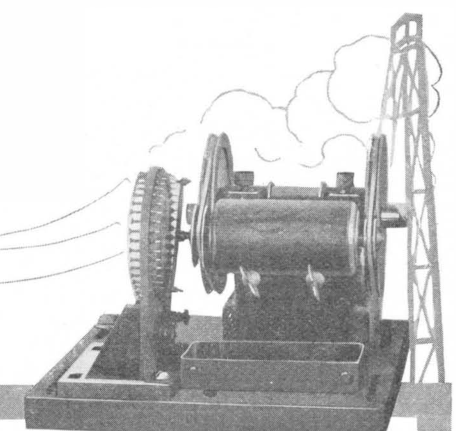
# The Principles of Radio-Telephony

## A Review of Recent Progress

By John L. Hogan, Jr.



Modulating relay. Used in 1907 tests for talking two hundred miles by radio.



Fessenden spark interrupter. Type used in 1901 to secure ten thousand sparks per second.

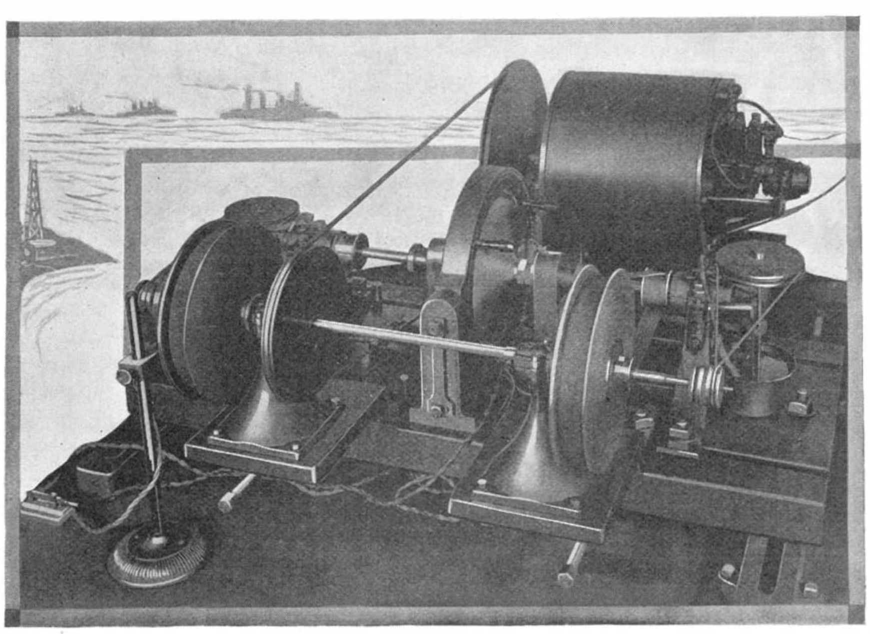
RADIO-TELEPHONY, or the transmission of vocal sounds by "wireless," bears much the same relation to wireless telegraphy as wire telephony does to ordinary line telegraphy. In each case of telegraphy the transmission of conventional signals representing letters of the alphabet is accomplished by sending forth electrical impulses in short and long groups, corresponding to dots and dashes, either into free space and guided only by the earth's surface (as in radio) or along a conducting wire. In each telephonic case there are sent out substantially continuous streams of small electric disturbances, in themselves too rapidly recurrent to produce individual effects of sound, which are guided either by a wire or by the earth's surface; these streams are modulated to conform to the conventional vocal sounds of language by some change in their characteristics.

In line telegraphy it is usual, by use of a "key," to start and stop a continuous flow of current at the beginning and end of each dot and dash, though some methods of Morse transmission use currents which are automatically interrupted or reversed at a rate high compared to that at which the key is manipulated. In these latter cases the telegraph key serves to turn on and off the stream of rapidly recurring impulses. The reception is effected, when direct current is used, by a sounder which clicks at the beginning and end of each impulse, or, in the alternating or pulsating current case, by a telephone which gives out a musical tone so long as the sending key is held down and the stream of impulses is permitted to flow. It is obvious that either method gives the receiving operator knowledge of the length of time the key is depressed, and therefore the ability to re-write dots and dashes (short or long signals) formed by the sender. It is equally clear that if pulsating or alternating current is used, with a telephone receiver, the variations in it must occur at a rate to which the receiver will respond to produce a musical tone, or say from 20 to 5,000 cycles of change in each sound, since otherwise the receiving operator could not determine the duration of each signal.

In radio-telegraphy it is customary to produce the required dots and dashes by starting and stopping groups of sparks, each of which emits a train of electromagnetic waves in the "ether," which waves travel to the receiving station. At the receiver, the impulse corresponding to each wave-train is transformed into a pulse of current and sent through a telephone receiver. Thus, if a dot is signaled by a short group of sparks occurring at the rate of 1,000 per second, at the receiver the telephone will be subjected to the action of a short group of current pulses at this same rate or frequency, and will give off for an instant a musical tone of the frequency 1,000 per second, which corresponds to about the second C above middle C on the musical scale. This short tone signifies to the receiver the transmission of a Morse dot, as a longer tone (produced by a longer group of wave-trains) would mean a dash, and it is by the various combinations of these dots and dashes in monotone that any written message may be spelled out by telegraph.

But in wire telephony conditions are somewhat different. In the first place, it is not required to signal mere time intervals, but the human voice, with its multitude of inflections and tiny variations, must be carried to the receiving station and there reproduced with fidelity. In the second place, the current which carries the voice vibrations must not in itself have any fluctuations unless these occur so rapidly that they will produce no marked effect on the receiving telephone. Otherwise a listener would hear a continual loud noise or tone which would sadly interfere with the transmission of articulate speech. Thus, for wire telephony, a steady flow of direct current has been adopted almost universally as the voice-carrying medium, and speech-wave vibrations are superimposed upon this direct current and reproduced as sound waves by the receiving telephone. Nevertheless, it has been demonstrated that easily understood speech can be transmitted by the use of pulsating or alternating current, so long as the variations are sufficiently rapid to produce of themselves only small effects at the receiver.

In wireless telephony the requirements are analogous. Direct current cannot be transmitted through the air or "ether" from sender to receiver, and so it became necessary to devise a method which would produce in the receiving telephone a steady or practically unvarying stream of direct current. When it is considered that in radio-telegraphy each train of waves creates finally a pulse of direct current, it is not hard to see that if the train of waves were sustained, or indefinitely lengthened, instead of being allowed to cease at the end of each spark, the resulting direct-current pulse would likewise be indefinitely lengthened into a steady flow of direct current. Or, alternatively, one might set up in the receiving telephone very rapid impulses (say at a frequency higher than 5,000 per second) by creating at the transmitter sparks which recur at a similarly high rate and each of which gives rise to a train of waves and a resulting pulse through the telephone. Impulses of such high frequency cannot produce strong individual effects in an ordinary telephone earpiece, and so by their use no interference with speech reproduction is made. Thus, it is evident that as soon as apparatus had been devised for setting up a long stream of sustained waves, or a uniform series of wave-trains at rates above 5,000 per second, one of the biggest obstacles in the path of radio-telephony had been overcome. The largest problem remaining was to find proper instruments for impressing the speech vibrations upon the emitted electromagnetic waves in such a way that their changes would affect the receiving telephone proportionally and so reproduce the vocal sounds. It will be noted that little has been said of the apparatus at the receiver, which collects the radiated waves and, remaining in operation continuously, converts them into current capable of operating a telephone. The development of this group of instruments, of which the essential element is the proportionally responsive "detector," was in itself a tremendous task involving a most radical departure from the typical receivers of early "wireless" telegraphy, and it was soon after its completion that the solution of radio-telephony was found.



Early Fessenden 50,000 cycle alternator, showing driving motor, countershaft and belted pulleys. The dynamo is in the center.

Since spark transmitters were already well known in the art of wireless telegraphy, it is natural that the first work toward producing oscillations and waves for telephony was with apparatus designed to make groups of waves at very high frequencies. A photograph of one of the earliest interrupters, of a type which before 1901 was used by R. A. Fessenden in connection with high-voltage direct current, is shown herewith. The original instrument was intended to allow sparking at the rate of 10,000 per second, and with it reasonably good speech was transmitted by placing in series with its aerial-wire circuit an ordinary carbon microphone telephone transmitter, which rapidly changed its electrical resistance when spoken into and so modified in accordance with voice vibrations the amount of current passing into the antenna. At the receiver the current passing through the telephone earpiece was forced to vary as the sending aerial current was altered, and articulate speech was thus reproduced. In spite of care in building the rotary interrupter spark gap, there were some small irregularities in its action which caused at the receiver such interfering sounds as are sometimes heard on a "noisy wire." Continued work along these lines resulted in better interrupters, but the simultaneous development of the radio-frequency alternator, or dynamo for the direct production of electromagnetic waves, provided a better instrument, and the interrupters were not much used for some years. Upon the adoption of the alternator* it at once became possible to produce perfectly uniform streams of sustained waves. To appreciate this, it is necessary only to understand that the radiant waves of wireless signaling are set up by rapidly alternating electric current in a system of aerial wires or antennæ, and that as the frequency of reversal or alternation of these currents grows greater and greater they set up electromagnetic waves which radiate more and more effectively. Alternating-current dynamos used for power and lighting ordinarily are made to produce from 15 to 60 or 120 periods or cycles of reversal of current in each second. Machines for special purposes are built to generate current of 500 or 1,000 cycles; but since even these relatively high frequencies cannot create vigorous radiation, in 1902 and 1903 a 10,000 cycle alternator was built and used for speech transmission, which proved quite satisfactory, though not entirely perfect. To secure better radiation it was necessary to use still higher frequencies, and therefore, in 1906, there was completed a dynamo giving current of 50,000 or more cycles, which could be connected directly to an aerial circuit and which would cause to be sent out a steady stream of waves. These, when received and "rectified" by the detector, gave in the telephone at the listening station a steady flow of current which was ideal as a basis for wireless speech transmission. The available power was greater than that obtainable when the spark interrupters were used, and this permitted talking to greater

* U. S. Patent 706,737; applied for May 29th, 1901; issued August 12th, 1902.

*(Concluded on page 296.)*

## The Books of 1914

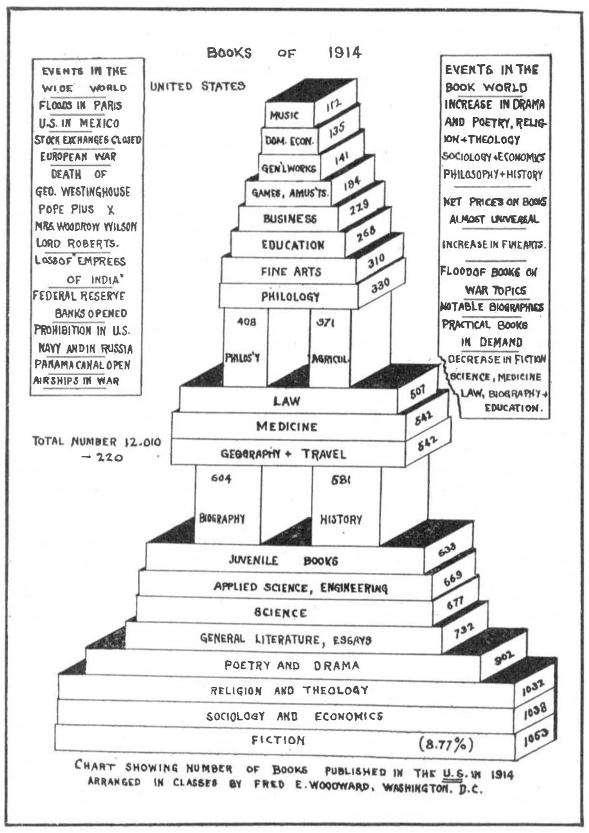
THE accompanying chart, compiled by Fred E. Woodward of Washington, D. C., showing the number and kind of books published in the United States during the year 1914, presents some interesting phases.

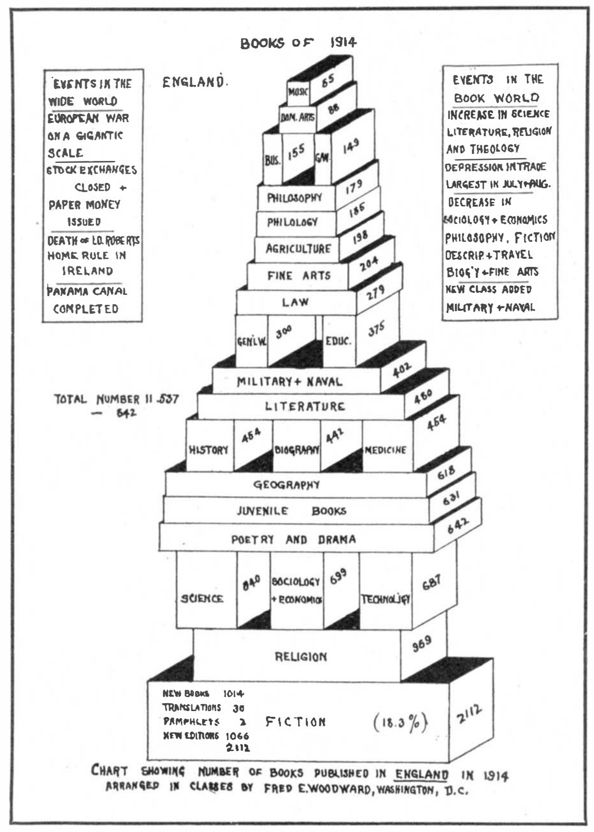
A glance at the chart shows a substantial pyramid of blocks or sections, each being marked with names and figures and representing the various divisions or classes into which, for convenience, the books of the year are divided.

The figures are taken from the *Publishers' Weekly*, and represent the actual number of books (by title) issued during the year. The grand total for the year 1914 was 12,010—just 220 less than the total for the year 1913. Of this number, 10,175 were actually new books, and 1,835 were new editions.

A further inspection of the *Publishers' Weekly* shows that American authors contributed 8,563 of this total, and foreign authors, mostly English, the remainder.

The extent to which we are further indebted to Europe is shown by 2,852 importations, the largest number, 330, being in the class known as Religion and Theology, followed by 246 in Fiction; 237 in Poetry and Drama; 223 in General Literature and Essays. The smallest number of importations was in classes known as Domestic Economy (15) and Law (16).




**Number of books in various classifications published last year in this country and in England.**

Perhaps the most remarkable growth is shown in the class known as Poetry and Drama—no less than 902 titles being recorded during the year. This class, as will be seen by referring to the chart, now occupies the fourth place, a change from the ninth place in 1913, and an increase of 223 in the year (from 679 to 902).

This growth records in a very forcible manner a decided movement toward poetic and dramatic ideals, which is more than local, and may be heeded by those who read the signs of the times.

Not only have our poets of to-day held their own, but new recruits have been found in the ranks of successful novelists, who, forsaking for a time the fields of romance, have clothed in dramatic form some of their most forcible expressions on the timely topics of the hour.

In the *Literary Digest* of March 1st, 1913, the writer called attention to the little appreciated fact that the proportion of Fiction to the total number of books published had been steadily declining since 1908, when the proportion was 16.1 per cent, to 1912, when it was only 9.3 per cent.

We have now to say that this *declining ratio still continues, and the astonishing figures of 8.77 per cent* are correct for 1914 (1,056 out of 12,010).

This remarkable showing should be gratifying to all who think we publish too much Fiction, and that something more substantial than frivolous stories should engross our attention.

To understand fully how great a transformation has been wrought one has only to go back to the year 1901 to find that the ratio of Fiction to the whole number was 27.4 per cent (2,234 out of 8,141).

It is worthy of note that a large percentage of Fiction published in the United States was written by American authors (689 out of 1,056).

The remarkable growth of books classed as Sociology and Economics began in 1907, in which year 521 books were issued, an increase of 185 over the previous year, and each succeeding year has seen an increase, until 1914, with 1,038 titles in this class, comes within 16 of winning the highest place and crowding out Fiction.

The marked interest shown by all classes of readers in this class of literature, well accounts for its consistent increase.

Religion and Theology also has a new record with 1,032 titles, and comes within 21 of Fiction, showing a fairly steady increase each year since 1900.

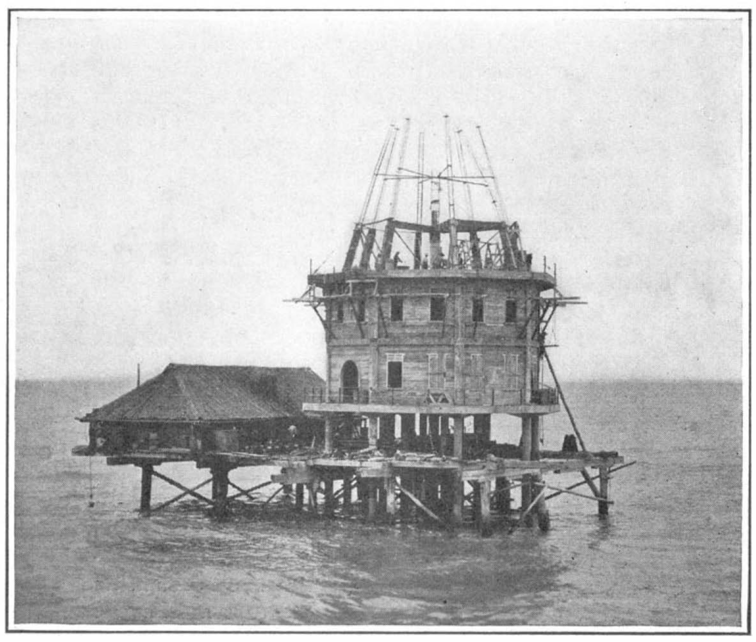
Philosophy shows a good gain and makes a new record (408 to 324 in 1913), and Fine Arts shows a gain of 46 (310 to 264 in 1913). Juvenile books, General Literature and Essays, Business, Domestic Economy, Music, and General Works are practically the same as last year, but the following show a loss: Science, a loss of 113 (677 to 790 in 1913); Applied Science, 102 (669 to 781 in 1913); Law, 185 (507 to 692 in 1913); Biography, 77 (604 to 681 in 1913); Medicine, 58 (542 to 600 in 1913).

In brief, out of practically the same number of books as in 1913, the year 1914 witnessed a decline in Fiction, Science, Law, Medicine, Biography, and Education, and a gain in Poetry and Drama, Theology and Religion, Sociology and Economics, Philosophy and History, while the remaining classes were changed but slightly from the previous year.

The notes on the margin of the charts are intended to call attention to some of the principal events or happenings both in the book world and in the world at large.

To a certain extent the events in the world are reflected in the books which we issue.

**War Planes for Italy.**—A large order for aeroplanes adapted for war purposes is said to have been recently placed with the Curtiss Aeroplane Company by the Italian government. These machines are to be of 100 horse-power, and are to be fitted with wheels for starting on land, and also with pontoons to enable them to be used at sea. They are to be capable of sustaining about 400 pounds, and are said to cost $7,500 each. It is understood that a large number of these machines are under order, and the Curtiss Company has two representatives with the Italian naval aviation corps to see that the flyers are properly set up and prepared as they are delivered.



**Building a lighthouse in Malacca Straits on piles sixty-five feet long.**

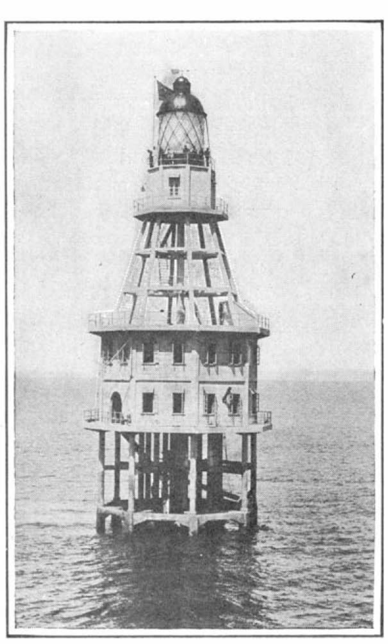
## Building a Lighthouse on Shifting Sand

**By H. J. Shepstone**

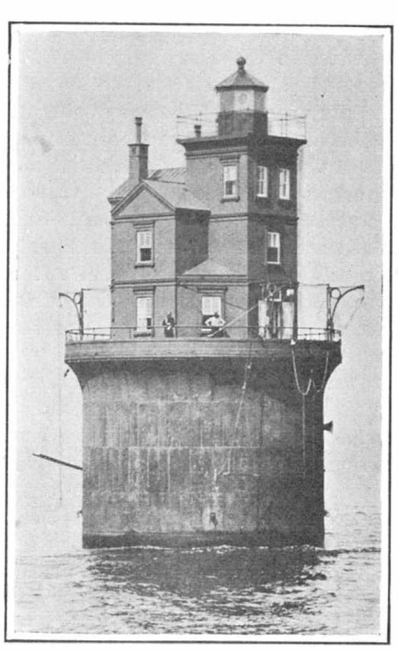
TO the many notable conquests of the lighthouse engineer we have now to add his triumph in erecting towers upon banks of shifting sand. True, such structures can be counted on the fingers of one's hand, but now that it has been shown that it is possible to place a permanent light upon a sandbank, other beacons will no doubt follow. Hitherto, on account of the extreme difficulties of the work and its high cost, the authorities have been content to mark such menaces to shipping with lightships.

It was the Germans who first showed what could be done in this way by their success in erecting a cylindrical tower upon a shifting shoal near the mouth of the Weser River, known as the Rothersand lighthouse. The water here, at low tide, is only some 23 feet deep, not sufficient for the great liners. Briefly, the plan followed consisted in sinking a huge caisson upon the site, filling it with concrete, and upon this more stable foundation erecting a stone tower. The first attempt proved a failure, and was nothing but a string of accidents.

In the first place considerable difficulty was experienced in towing the caisson to the site and also in sinking it. During the night that followed its settling down upon the bank the workmen who were left upon it experienced an anxious time. Their novel home suddenly began to move and to heel



**One-Fathom Bank Lighthouse in the Malacca Straits.**



**Lighthouse built on a sandy shoal in Delaware Bay.**

**Rothersand Lighthouse in the North Sea.**

over to one side. The list grew more pronounced as the hours went by, so much so that the men could not keep their feet, and were forced to remain clinging to the elevated end of the structure. Every moment they expected the caisson to heel over and throw them into the sea. At dawn, however, they were rescued from their perilous position by one of the construction boats. After many weary months of work, when it began to look as if the efforts of the builders would be crowned with success, a terrible gale arose. The men were hastily got off to the mainland, but when they looked across the ocean next morning they could see no sign of the caisson, which had disappeared beneath the waves.

The second attempt, however, proved successful, though several times it looked as if the sea would again rob them of victory. This second caisson was certainly a mighty structure, measuring 46 feet by 36 feet, and towering over 60 feet high when launched. Its shell alone weighed 245 tons, and with the various accessories aboard the weight was brought up to some 335 tons. It was taken out to the site in charge of five tugs, but a sudden thunderstorm coming on, the unwieldy structure broke loose and was washed ashore. At last, however, after many vexatious delays, it was pulled and pushed, nudged and coaxed, to the proper spot. Here it was sunk, the water pumped out, and the men, descending into the lower chamber, removed the sand to allow its edge to sink deeper and deeper into the bank. At the end of twelve months the bottom of the caisson was buried 73 feet below low-water mark, and its weight increased to some 4350 tons. Then, to prevent erosion, huge mattresses of brushwood were sunk around the base of the tower, held down by boat-loads of broken stone. For this protective work alone over 176,000 cubic feet of brushwood and 600 tons of blockstone were requisitioned. The tower rises no less than 75 feet above the top of the caisson, so there is as much below the surface as there is above.

Three years later the United States lighthouse engineers planted an iron tower on Fourteen Foot Bank, over three miles from the shores of Delaware Bay, in twenty feet of water. As in the case of the Rothersand structure, a large caisson was built on shore, towed out to the site, and sunk. It proved a troublesome and weary piece of work, and a most anxious time for all concerned. The caisson refused to settle down properly on the shoal, tilting dangerously to one side, and it was only by the employment of heavy weights and by virtually creating a bed for it that serious trouble was averted. When the huge tub had righted itself concrete was poured into it, forming a solid circular rock sunk into the sand, and as firm and free from vibration as a granite core. Upon this foundation rises a circular iron tower, upon which is perched a house for the keepers, the whole being crowned by a lantern.

The engineer's latest conquest in crowning a dangerous shoal with a permanent light is the recently-completed beacon, known as the One-Fathom Bank lighthouse in the Straits of Malacca, in the East Indies, some sixteen miles off the coast. Until quite recently the waters here were guarded by a lightship, but the position is very open, and so exposed to the full fury of the gales that the vessel frequently dragged her anchors, so that the warning beacon became somewhat uncertain.

In this particular instance, however, the caisson idea was abandoned, and recourse was had to piles, disposed in two concentric rings, the whole being well braced together. When it is stated that the piles go down into the sand till they touch solid rock at a depth of 28 feet, and have each a total length of some 65 feet, it will be seen that their transference to the site and the driving of them into the sea-bed was no mean feat.

The piles, which were made of steel and were hollow, were, in fact, floated to the scene of operations by barrels. Here they were raised and driven home, the final blows being delivered by a "monkey" weighing two and a half tons, dropping from a height of four feet. As the piles disappeared into the sea-bed, they were lengthened by the attachment of further sections. Into them concrete was then poured. These piles support a platform some twenty feet above the surface of the ocean, upon which stands a pretty two-story dwelling, where the keepers live, and where the stores and oil are kept. Thirty feet above this, held aloft by eight columns, comes the lantern.

## A New Engineering Medal

LEONARD C. WASON, who has just been elected president of the American Concrete Institute, has offered a new prize to be awarded annually by the Institute to the author of the best paper submitted to the Institute during the year. Competition is restricted to members, and the papers must be original in every respect and not previously published elsewhere. All papers submitted to the Institute for publication in the annual volume are eligible to this competition, but the board has the privilege of withholding the medal any year in which no papers of sufficient merit are presented.

## Another Aviator Perishes

TO be obliged to record the death of another aviator, and especially one of the ability and character of Lincoln Beachey, is a matter of great regret, but can hardly be a surprise to those who have witnessed the sensational feats of this brilliant performer. Beachey was drowned at San Francisco on March 14th, when the wings of his monoplane collapsed as he was making one of his terrific vertical dives, and he sank in the waters of the bay strapped to the remains of his machine. The fatal drop was made from a height of about 3,000 feet at the Panama-Pacific Exposition, and after plunging for a great distance head down he attempted to straighten his machine out for his usual graceful landing, when the wings of his new monoplane, a machine of his own design, and of excessively light proportions, crumpled up under the terrific strain, and turning over and over, he fell helplessly into the water.

He had performed this feat repeatedly with biplanes; and with his new monoplane, which was the fastest machine he had handled, he had a few minutes before the accident successfully looped the loop and made an upside down flight. He was considered the most formidable rival of the Frenchman, Pegoud, as a stunt performer; and in this connection it may be noted that it is claimed that Beachey had the loops, spirals, and dives that made Pegoud famous all figured out long before the latter performer startled the world with these feats, but his backers persistently refused to permit him to carry out his plans until Pegoud had proved them possible.

Beachey was one of the earliest air men, having performed for a number of years with little exhibition dirigibles having the well-known cigar-shaped bag, but he did not take up the work with planes for several years after these new craft had become well known, but almost immediately assumed a leading position as one of the most skillful and daring aviators in the world. Beachey was only 31 at the time of his death, but his brilliant feats and modest, unassuming disposition had made him extremely popular with both the public and his fellow flyers.

## A Seven-ton Giant Reptile Seven Million Years Old

BETWEEN seven and ten million years ago, in what is known as the Jurassic Age, there lived a group of giant reptiles called Dinosaurs, one family of which, the Stegosauridæ, or plated lizards, is perhaps the most fantastic and curious in all natural history. The most perfect and complete fossilized skeleton of the genus Stegosaurus, a smaller branch of this remarkable family group, is on exhibition in the new building of the U. S. National Museum, at Washington, just as it was found and dug out of the sandstone rock. Near at hand is a natural size and very lifelike restoration in *papier-mache*, so weird and monstrous in appearance as to give one the horrors.

Back in the very early days of the world this armor-plated lizard-like monster dwelt in the western part of the United States in what is now the eastern slope of the Rocky Mountains, although at that time the mountains did not exist. He roamed about in the marsh and swamp lands of that region, feeding on the tropical grasses and plants, the fossil remains of which are found buried with his skeleton. The specimen mentioned above comes from Quarry No. 1, in Fremont County, near Canyon City, Col., where it was found by Mr. M. P. Felch in 1885. Brief articles concerning it were written from time to time, but it was not assembled and mounted until two years ago, and never completely described until recently. With the exception of the removal of some of the sandstone which surrounds this valuable specimen, it has been left in the position in which it was discovered so that the relation of the various bones and skin armor may be seen and studied by scientists. In order that the lower side of the skeleton and the back plates may be seen, two mirrors have been placed beneath it in such a manner as to reflect the exact structure and location of the various bones.

The undisturbed position of the bones and the surrounding sandstone indicate that this monster died in the water or on the bank of a stream, and from some natural cause. It is possible that the carcass floated down the stream, as the arrangement of the different bones and spine plates indicates a gradual washing and tipping over, rather than the crushing action of a heavy force. The skeleton is quite complete and lies partly on its side and back, with nearly all the bones in their relative positions, rendering it of infinite value to scientists for study and as a reference type.

In life this peculiar reptile of such gigantic proportions must have presented a forbidding appearance; it measures about nineteen feet in length, was evidently over eleven feet in height at the hips, and was covered with a very tough and horny scale-like skin, studded here and there with bony buttons or knobs of armor. Along its back were arranged great sharp-edged plates set alternately and projecting upward like the teeth of a huge saw. This odd armor-plate extended from the small wedge-shaped reptilian head all the way back and well down the tapering lizard-like tail, which was tipped with four long, sharp spines. Its legs were not unlike those of a lizard or other reptile, except that the fore legs were rather short and much weaker than the hind ones, an indication that the great animal could sit up like a kangaroo, and perhaps descended from a bipedal ancestor. From a study of its teeth it has been determined that this prehistoric beast was a plant eater, as is suggested by its habitat. Further investigation of its head, which is so small as to be quite out of proportion to its massive body, reveals the fact that it had scarcely any brain. Although the body of the Stegosaurus is supposed to have weighed more than that of an elephant, the brain of the latter is fifty times as heavy, which fact offers an excuse for the immense amount of defensive armor with which it was equipped, making it practically impregnable as far as its enemies were concerned, provided it had any. Its bones alone weigh nearly a ton, and it has been estimated that in life the Stegosaur weighed between seven and ten tons.

A very complete scientific treatise on this interesting group of extinct giant reptiles by Mr. Charles W. Gilmore, assistant curator of fossil reptiles, has just been published by the U. S. National Museum in the form of a bulletin, the edition of which has been distributed to libraries and to scientific and educational institutions.

## New Gasoline Engine Drive

TO carry out gasoline engine drive upon various machines which are subject to irregular working, that is, giving rise to shocks at full load and full speed, a belt drive was preferred to couple the motor, for instance, to a thresher. When a brusk shock occurs, the belt can slip on the pulley or even fly off, and this avoids harm to the mechanism and breakage of parts. Realizing the great advantage which would be gained by a direct coupling of motor to thresher and mounting the motor on the same, instead of spending time to set up motor and thresher separately and line up pulleys and belting, a special patented motor combination due to Allart and Savarit is made by the Paris De Dion works. While the use of belt drive can be retained in permanent plants, it will be seen that the direct drive is a great improvement in portable machines. The problem of direct coupling on the class of machine we referred to above has been now successfully solved by the inventors. A flat circular box contains a differential mechanism, with means for slipping on to the end of the machine shaft in place of the usual pulley, such box being then bolted on the side of the thresher, and a short universal joint rod connects the differential to the gasoline motor, which is also mounted against the side of the machine. The motor drives the set of satellite gears. One of the principal gears drives the machine shaft, and on the second large gear is a brake shoe. Brake is set by lever to make its effect equal to what is needed to run the machine (or somewhat higher), but the brake action is adjusted to be less than the maximum of the motor. Normally the motor runs the machine only, for the brake part has the higher effect and is hence idle. But in case of sudden resistance given by the machine, the other side comes into play, that is, the brake wheel is now driven instead of the machine. Such device, while keeping always in gear, runs with constant speed of the motor, or in other words constant power, this being a great advantage.

## The Current Supplement

THE discoveries of the last few years have shown that an atom is quite a world in itself, and as the properties of atoms are of importance in so many branches of science, the article on Recent Evidence for the Existence of the Nucleus Atom, in the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT, No. 2047, for March 27th, 1915, will be read with more than usual interest. Watching the Earth Revolve describes a simple instrument that enables us to directly observe and measure the revolution of the earth. The Economies of Home Lighting surveys the various systems of lighting, and makes comparisons of cost of direct value to every householder. The Science of the Tariff tells of one of the ways in which science has been called to the aid of the Government. An Airship in the Field is the personal story of a member of the crew of a big German Zeppelin, describing a voyage of observation. Photographing Projectiles gives a series of pictures illustrating a series of experiments in this interesting field, together with useful notes. Making Steel by Electricity illustrates the construction of the most important furnaces devised for this important branch of manufacture, together with many details and much valuable information. There is an interesting story on the history of the celebrated "Damascus" sword blades, and the article on the Reaction of the Planets Upon the Sun is concluded, besides much other information.

# Correspondence

*[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]*

## California's Horse-power Formula

To the Editor of the SCIENTIFIC AMERICAN:

I desire to call your attention to a misprint in the SCIENTIFIC AMERICAN, issue of January 30th, page 95, column 2, under the caption "California Has a New Horse-power Formula."

The formula should read.

$$HP = 0.224\ ND\ (D + L)$$

with the same notation as published.

San Francisco, Cal. J. P. ZIPF.

## Light from Film-pack Paper

To the Editor of the SCIENTIFIC AMERICAN:

Referring to the letter "Light from Electricians' Tape," it may interest your correspondent to know that this light also appears in stripping the black paper from film-pack films preparatory to development. In this case, of course, one's eyes are accustomed to the pitch blackness of the dark room, and so the slightest glimmer would be discernible, but I think the light is fully as intense as that given off by the adhesive tape.

New York city. A. F. L.

## A Projectile for Destroying Dirigibles

To the Editor of the SCIENTIFIC AMERICAN:

I note in your issue of December 5th, 1914, a projectile useful in the destruction of dirigibles, also in your number of February 13th, in which you show cuts of a projectile which penetrates the balloon fabric and at the same time explodes. I wish to say that several years ago I submitted to the United States Navy at Washington, D. C., drawings and specifications of an incendiary projectile useful in the destruction of dirigibles. The same on piercing the fabric would open knife blades and cut their way through the fabric. The opening of the knife blades causes certain fulminates to ignite or explode the gases in the bag contained therein.

Trenton, N. J. G. GUY MILLER.

## How the Late Charles M. Hall Became Interested in Aluminium

To the Editor of the SCIENTIFIC AMERICAN:

I notice that in a recent issue of the SCIENTIFIC AMERICAN you make mention of the death of Charles M. Hall, of aluminium fame.

You might be interested to know that it was the reading of the SCIENTIFIC AMERICAN that first interested Mr. Hall in a method of extracting aluminium from the clay earths.

I distinctly remember being at his father's home in the fall of the year 1880, when he was about sixteen years of age. One Sunday afternoon, in taking a walk with him, he explained to me that there was a valuable metal contained in the clay which abounds in northern Ohio, with many of the qualities of copper, and that if a cheap method of extracting the same could be found, the metal would be of very great use in the arts. Although he was a little older than myself, I expressed my incredulity, but he assured me that he had read about the matter in the SCIENTIFIC AMERICAN and it could be depended upon.

I think there is no question but that beginning from his perusal of the SCIENTIFIC AMERICAN when he was a mere boy, he never gave up his determination to find a method for the production of aluminium uutil he, while still a very young man, succeeded in his purpose.

Manchester, Iowa. E. B. STILES.

## Ventilating the New Subways

To the Editor of the SCIENTIFIC AMERICAN:

I have given considerable attention to the subways as to the easiest and best method of ventilating them and make the air as pure as we breathe in the streets, since the first tube was built to the present tubes in course of construction in the city of New York.

Take the Seventh Avenue and Broadway tubes, where improvements in ventilating could be easily installed at a small expense over the original cost.

The openings into the tubes for entrances and exits will probably be similar to the other tubes, each about from 4 feet wide to 8 feet high, through which the air will pour in, and in order to give perfect vent to the tubes, use pipes 2 and 4 feet in diameter 15 feet high from the ground, with a goose-neck top; place near the gutter on the sidewalk or against the houses, and run pipes of the same dimensions from the side of the tube and connect with the pipes above the sidewalk, and in each opening into the tube for the pipes a fan should be installed, to cause a circulation. Stations five blocks apart, with two openings for exits and two openings for entrances on one side of the avenue or street and the same number on the other side, making eight openings in all, each 4 by 8 feet, on each side of the tube on the street between stations; there should be eighteen goose-neck pipes, 2 by 4 feet in width, and you will have a subway free from all bad odors, the smoke from fires and oppressive heat, and the air in the tubes will be as pure as we breathe in the street. Fans must be used to cause a suction in the pipes; without fans the wind will blow down.

If the pipes are 15 feet high above the walk, the tops would not be tampered with, and no rubbish could be thrown within. Goose-neck tops prevent down draughts to a considerable degree.

The above plans would not suffice where sidewalk ventilators are installed. There would have to be more pipes used unless the gratings were covered.

New York city. J. WESLEY SMITH.

## Sir Hiram Maxim on the Maxim Gun in War

To the Editor of the SCIENTIFIC AMERICAN:

I am sending you inclosed a newspaper cutting and also a note that was handed in to me by Mr. D. George Collins, a very important business man, who has great influence in political matters. Like myself he is a chevalier of the Legion of Honor.

On Sunday last a soldier from the front called at my residence. He had been wounded and had returned home. He said he wished to see the inventor of the Maxim gun before he returned to the front. He told us that on the Kaiser's birthday the Germans charged in solid formation, their object being to rush the English trenches and bayonet the defenders, but the British had three Maxim guns concealed and ready for them, and when they suddenly opened fire the stream of bullets cut regular canals through the Germans and that very few of them escaped. He said from his own experience at the front he believed that more than one half of the casualties of the present war were due to the Maxim gun. He said that if they had not had the Maxim guns they would have stood no chance whatsoever against the enormous German forces that were sent against them. The Maxim gun, without question, had saved the situation. He asked permission to shake hands with me. HIRAM S. MAXIM.

West Norwood, London, S.E.

P. S.—An English officer has said that the Maxim gun lends itself much more to the defense than to the attack. H. S. M.

[The following is the cutting sent by Sir Hiram Maxim: "In Paris last week I met an officer who stated that in one of the big engagements the English had fifteen Maxim guns. They were masked by lines of British infantry. The Germans attacked in swarms, and as they came within short range the British soldiers opened out, fell back, and the Maxim guns in three minutes left dead 5,000 of the Germans. The Germans did not expect the guns to be concealed behind the ranks of soldiers."—D. George Collins, February 9th, 1915.]

## Acoustics of Auditoriums

To the Editor of the SCIENTIFIC AMERICAN:

"Acoustics of Auditoriums," by F. R. Watson, in SUPPLEMENT, No. 2031, was interesting to me, from the fact that in 1889 I had the privilege of hearing a Mormon elder in the Tabernacle at Salt Lake, where, as is well known, a pin dropped at the pulpit can be heard in the extreme rear. On my way to Philadelphia it occurred to me that few buildings possessed those acoustic properties. Not being scientifically educated, I must tell you in common language what I reasoned out in 1889—then a young man—which may help some builder.

The ideal building for the easy flow of sound waves is hemispherical, and it also is equally valuable to the return or echo waves. Curtains and wall ornaments retard the return of echo waves, but they also prevent the easy flow of the original waves from the stage. So that walls free of draperies are nearer the ideal. To produce an echo in a hall or auditorium the sound waves first reach the extreme rear and returning mix with either their own waves traveling sidewise or with new sound waves, which are stronger, forcing them to the sides of the building. I concluded then that the nearest approach to the perfect auditorium would be a hemisphere, without draperies on walls, and standing on stage looking toward audience, all lines would be streamlines, or as I said in 1889, lines of beauty; and standing at rear, looking toward stage, all lines would be irregular; also at rear, equidistant along both sides, would be a recess or alcove. Looking from the stage no break in the walls or ceiling would be noticeable. The sounds would travel unobstructedly; looking from the rear the walls and ceiling would resemble somewhat the gills of a fish, which would prevent to a great extent echo waves. A building so constructed would, I think, make it difficult for the original sound waves to reach the stage from the rear, if the orator stood at the rear and tried to make his words reach the stage. A building constructed on those lines would also open up a new world for the artistic painter.

A smooth rear wall helps the echo waves. The alcove or recess I mention would be in center rear wall as a "sound catcher." When the sound waves reach the rear wall they have performed their duty and should die there. T. E. PHILLIPS.

Jack Wade, Alaska.

## Musical Pitch to the Eleventh Decimal

To the Editor of the SCIENTIFIC AMERICAN:

In your December 26th, 1914, issue is a communication from Mr. E. H. Hawley giving the vibration numbers of the notes of the equally tempered musical scale. This is based on international $a'$ with 435 vibrations per second. The long strings of figures after the decimal points look so important that it seems in order to call attention to the futility of such calculations, and the fact that they have no significance musically. Let us consider the $c''$ . . . 517.30509506692. If this $c''$ is sounded with the $a'$ 435 an imperfect minor third results, since the perfectly harmonious minor third should make 522 vibrations per second (6/5 equals 522/435). In other words this equally tempered minor third is sufficiently flat to produce nearly five beats in a second. If the table gave the vibration number of $c''$ as 517.30509506693 (last figure three instead of two) this $c''$ would be a higher pitch than the $c''$ figured by Mr. Hawley, and would make one vibration more in one hundred billion seconds. As there are only 86,400 seconds in a day the two $c''$'s if sounded continuously together would require well over 3,000 years for each beat. It is hard to see how figures in this class can properly apply to any musical problems, practical or theoretical.

It would appear also that the vibration numbers given for the siren disk of the "optophone" are merely copied from the extended table already discussed without regard for the established practice when discarding decimal figures. As the optophone will have a certain whole number of holes in each circle, the vibration numbers cannot be made to correspond so closely to the figures of the equally tempered musical scale.

Schenectady, N. Y. JOHN B. TAYLOR.

## How to Make Carbon Positives

To the Editor of the SCIENTIFIC AMERICAN:

The following method of making positives on glass is an adaptation of the well-known gum bichromate process. Briefly, it consists of making gum bichromate prints on ground glass, then varnishing the latter to give the required transparency.

Coating: Coat with the following:

(A) Potassium bichromate (saturated sol.), ⅔ ounce.
(B) Gum arabic (saturated sol.), 1 ounce.
(C) Lamp-black (or equivalent color), 40 grains.

B is prepared by suspending 2 ounces of clear gum contained in a muslin sack in six ounces of distilled water. Allow to stand for at least twenty-four hours. Mix A and B. Put the lamp-black on a clean ground glass, add a little of the gum solution, and grind with a glass strip to a uniform consistency. After grinding carefully and thoroughly, mix this with the remainder of the solution.

Coat the ground glass surface of the plates with a camel's hair brush, using just enough of the solution in each instance to give a uniform dark gray tint when viewed by transmitted light. A second soft brush should be used to even the coating as much as possible so as to obliterate brush marks which would show in the finished print. The coated plate must *not be opaque* in any part. The plate should be dried in the dark, which takes only a few minutes to accomplish. The writer uses a small bake oven placed near a stove as a drying oven.

Exposure: An average negative will require from three to five minutes in bright sunlight.

Development: Soak in cold water for several minutes, then gradually raise the temperature of the water until development begins. The exposure should be so timed that development proceeds automatically, as any mechanical assistance other than moving the plate gently through the water will destroy the finer details. Because of the rigid glass backing, the image is easily destroyed by even a slight touch of a soft brush. Hence, soak the plate face down, for several hours if need be, until finished.

When the development is completed, dry and varnish with a quickly drying pale oil varnish. Pour a pool of varnish on the center of the plate, allow to flow over the entire surface, drain, and dry face up in a place protected from dust. Mount in cardboard frames with *passe-partout* binding.

Some causes of failure: Brush marks are due to uneven coating. Loss of detail, or damaged image, may be due to rough handling in development. Too thick a coating of gum-pigment results in the film's peeling off in development. CLAUDE C. KIPLINGER,

Department of Chemistry, Iowa State College.
Ames, Iowa.

# The Superheated Steam Unit

## Some Remarkably Economical German Engines

By Warren H. Miller, M. E.

THERE are three advantages inherent in the use of superheated steam; first, the fundamental law of thermodynamics, which states that the greatest efficiency follows when the given medium is used at the highest possible temperature and rejected at the lowest; second, the fact that superheated steam does not readily condense on cold cylinder walls, thus resisting the heavy losses that follow from cylinder condensation; finally, superheated steam occupies a greater volume per pound than saturated steam—at 300 deg. Cent. superheat is 1.26 times the volume of the same steam saturated—so that a pound of it will do more work than a pound of saturated steam.

Its practical disadvantages when used in an ordinary steam plant are so many that little progress in its use has been made in the United States. The ratio of heat interchange between chimney flue gases and the superheated steam inside the superheater is so small as to make a clean, non-sooted metal surface an essential (Gutermuth, *Versuche über die heissdampf Lokomobilen*, 1910). In lokomobile practice the superheater is blown clear of soot every twelve hours with an especial revolving steam jet for the purpose.

Again, a sufficiently high superheat to eliminate cylinder condensation is only reached around 570 deg. Fahr. and this comprises reheating of the high-pressure exhaust before admitting to the low-pressure cylinder in order to eliminate the cylinder condensation there. The valve gear and lubrication facilities of an ordinary steam engine will not do well at such high temperatures, and to carry superheated steam long distances from boiler- to engine-room, back to reheater and return to low-pressure cylinder of an engine at temperatures of 570 degrees and 450 degrees, respectively, is out of the question with ordinary commercial steam pipe packing.

Third, a tubular boiler designed to evaporate a maximum of saturated steam is in no way suited to be used with a superheater. Its tubes are of such a length as to deliver the flue gases to the uptake at about 410 deg. Fahr., while what is wanted for efficient superheating is around 800 to 900 degrees. With water-tube boilers this disadvantage does not hold, since the superheater can be located with more freedom.

These disadvantages of the ordinary steam plant led to the development in Europe of the superheated steam unit or "lokomobile," described by the writer in the columns of the SCIENTIFIC AMERICAN, March 9, 1912, p. 213. During the last fifteen years over 60,000 of them have been built, aggregating four million horse-power. In general principles they are all founded on the idea of compactly assembling everything needed to make and use superheated steam in one unit. The engine is mounted on the boiler, even in 1,000 horse-power units; the fire tubes are short and the remainder of the smoke box is occupied by one or more superheaters. The boiler is internally fired, with corrugated furnace; there is no radiation and no long line of piping from boiler to engine.

Owing to the successful utilization of highly superheated steam, these units develop remarkable economies, averaging less than 1.5 pounds of coal and 10 pounds of steam per brake horse-power in all sizes from 40 horse-power to 1,000 horse-power, and not losing this notable economy appreciably at either underloads or overloads.

This astonishing statement has been proved beyond question by hundreds of tests made during the last ten years by such eminent European authorities as Profs. Josse of Berlin, Gutermuth of Darmstadt, Mathot of Brussels, Burstall of London, and Schroeter of Munich. I give below summaries of ten of the more important lokomobile tests made upon various sizes of Wolf lokomobiles.

A description of the various superheated steam units that figured in the above tests may prove interesting, for they cover the whole range of lokomobile practice from the earlier types of 1900 to the latest construction, the compound uniflow cylinder 300 to 800 horse-power line recently put on the market by the R. Wolf Company of Magdeburg, Germany.

Beginning with Test 1, Wolf, 180 horse-power, tested by Gutermuth in 1901, the following description will give a fair idea of the general construction. The boiler is of the horizontal tubular type, with removable tubes and corrugated shell furnace, permitting easy and thorough cleaning. Owing to the very low fuel and water consumption of the lokomobile it is feasible to use a compact internally fired boiler, for even in the 250 horse-power size the grate is only about 4 feet 6 inches by 3 feet 6 inches in area. The tubes are much shorter than those of a saturated steam boiler. Not only have they much less steam to evaporate to produce a horse-power, but they must deliver the flue gases to the superheater at a high temperature, 700 to 900 deg. Fahr. In front of the tube sheet is the superheater coil, bearing a ratio to the boiler heating surface of about 250 to 75. In front of this is a revolvable steam jet pipe, used daily for the purpose of blowing off the soot and ash, an essential feature in order to get real efficiency from the superheater.

On the rear end of the boiler is a cast iron shell, containing high and low pressure cylinders. This shell is riveted to the boiler and is not only the steam dome, but also a live steam jacket for both cylinders. At the forward end of the boiler is riveted the crank-shaft saddle, and since the engine stresses pass through the boiler shell, the alignment and adjustment of valve laps and center distances are made under full steam pressure and working temperature.

The steam from the boiler is led inside the shell to the front and passes through it by a double lock nut joint to the superheater. The steam is at about 160 pounds boiler pressure (11 atmospheres) and the superheater gives it a temperature around 570 degrees, whence it passes direct to the engine by a short, heavily insulated pipe. The expansion is divided between the two cylinders so as to allow the steam to enter the low pressure cylinder with as much superheat left as possible, so as to eliminate cylinder condensation in that cylinder also. Lokomobiles of this type are good for 10 to 11 pounds of steam per brake horse-power hour.

The next advance in the lokomobile was to turn the engine around and mount the cylinders tandem, as in Figs. 1, 2, and 3, placing the low-pressure cylinder as before in a sort of steam-dome jacket with the high-pressure behind it in a casting, forming part of the chimney uptake. Turning the engine around also made the steam piping problem easy, so that a second superheater was introduced between the high and low-pressure cylinders, for it was found out that cylinder condensation would occur in the low unless excessive superheats were carried. This second superheater was made multiple coil, as it had to handle large volumes of steam at low pressures. It takes the steam from the high-pressure cylinder at about 260 deg. Fahr. and reheats it to 380 degrees, the flue gases entering the chimney at about 430 degrees after passing through this superheater and passing around the walls of the high-pressure cylinder. This type of engine is made in sizes from 40 to 80 horse-power and the 40 horse-power size as tested by Prof. Josse in 1904 gave a steam economy of 10.9 pounds per brake horse-power hour.

This was surpassed by the later type shown in Fig. 4. In this lokomobile the steam-dome jacket feature has been discarded entirely, and both cylinders are mounted tandem in a hood over the smoke box; the main chimney uptake leading out of this hood. Otherwise all the general features of the previous type have been retained. It is made in sizes from 130 horse-power to 650 horse-power, and at present holds, so far as I am aware, the world's record of steam and coal economy at 7.05 pounds of steam and 0.79 pound of coal per brake horse-hour. This was obtained only, however, by the excessive superheat of 806 deg. Fahr., though neither engine nor lubricating oil showed any distress at that temperature. As the reader will note by Test 4, the ordinary economy of this type at 626 degrees superheat is between 8 and 9 pounds.

Test No. 5 is of an interesting lokomobile, Fig. 5, a representative of the 300 to 800 horse-power line, cross-compound, double superheat. It was the 650 horse-power engine of this type which, running in parallel with a 1,000 horse-power Lanz lokomobile, furnished a large part of the electric light and power used in the Brussels Exposition of 1910. It probably represents the limit both in size and economy of the steam dome-jacketed piston-valve engine. The double superheat feature appears also in this lokomobile, and as tested by the Exposition judges it gave 8.70 pounds of coal and 1.02 pounds of steam per brake horse-hour on a superheat of 649 deg. Fahr.

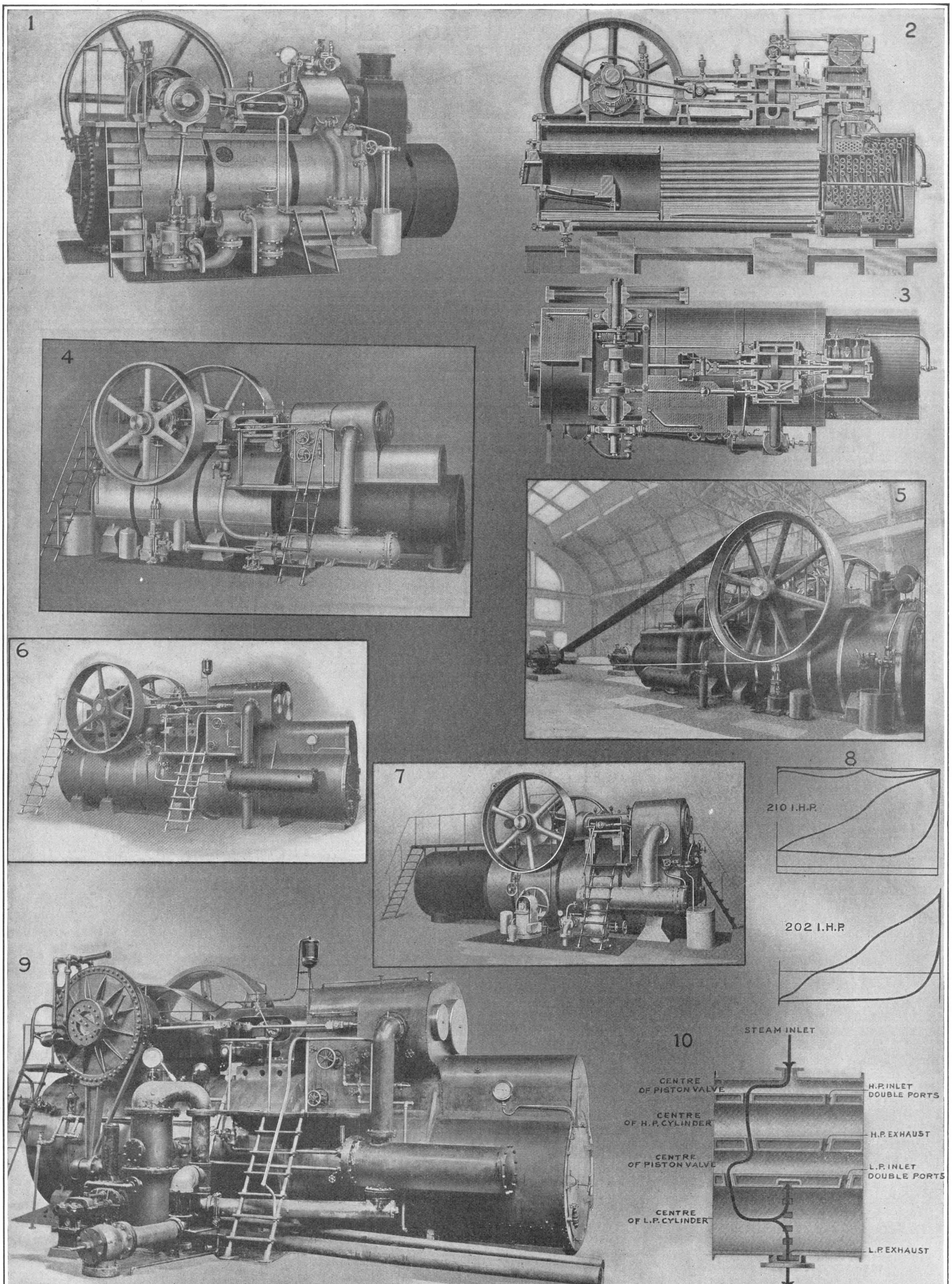
During the last two years the Wolf Company has developed what may be termed the latest advance in the lokomobile—the application of the uniflow cylinder principle to these superheated steam units. The test results, as obtained by Prof. Doerfel of Prague, are given in No. 6. Note that an economy of 8.9 pounds of steam was obtained on a superheat of 644 deg. Fahr., a remarkably low consumption with superheat well within the limits of practical operation. It may seem like double use to employ both superheated steam and the uniflow cylinder principle to eliminate cylinder condensation, but whatever is good for saturated steam is as good for superheated, wherefore the uniflow type. Briefly described, the steam passes into the cylinder by the inlet port, produces the stroke in expanding, and then escapes by a central outlet port uncovered by the piston at the end of the stroke. There is thus no exhaust stroke with its cooling effect on the cylinder walls; in fact, the passage of the steam in one direction only produces a set of annular differential temperature areas on the cylinder walls corresponding closely to the varying temperatures of expansion, so that the tendency toward cylinder condensation is very small. Further, it has been found that the use of constricted cylinder ports alternately by hot live steam and cold exhaust steam at every stroke introduces a lot of condensation before the steam ever gets into the cylinder at all, and this loss the uniflow arrangement eliminates entirely. (Engine and cards shown in Figs. 7 and 8.)

To work this out in practice the Wolf Company engineers had to devise a cross-compound uniflow cylinder engine. This was done by making the pistons of both cylinders relatively long in proportion to the stroke and putting in piston valves to control admission to high and low-pressure cylinders. The exhaust ports of the high-pressure cylinder are on the opposite side from the inlet ports and are located somewhat further inward toward the center of the cylinder instead, as shown in the diagram. These ports are uncovered by the piston toward the end of the expansion stroke and the steam thus escapes to the low-pressure receiver. It is admitted to the low-pressure cylinder and then prevented from "backing up" into the high-pressure by the low-pressure piston valve during the succeeding stroke. Part of it is trapped in the high-pressure cylinder and serves as a cushion during the return, but a real exhaust stroke, such as has been tolerated in ordinary

(*Concluded on page 296.*)

| No. | Date | Manufacturer | Horse-power | Coal (pounds). | Steam (pounds). | Super-heat Degs. Fahr. | By Whom Made. | Type of Lokomobile. |
|---|---|---|---|---|---|---|---|---|
| 1 | 1901 | Wolf | 180 | 1.5 per B.H.P. hour | 11.2 per B.H.P. hour | 570 | Prof. Gutermuth, Darmstadt | Cross compound, single superheat. |
| 2 | 1904 | Wolf | 432 | 1.32 per B.H.P. hour | 10.9 per B.H.P. hour | 590 | Prof. Josse, Berlin | Tandem compound, double superheat. |
| *3 | 1910 | Wolf | 138 | 0.789 per B.H.P. hour | 7.05 per B.H.P. hour | 806 | Magdeburg Boiler Association | Tandem compound, double superheat, chimney cylinder jacketing. |
| 4 | 1910 | Wolf | 105 | 1.04 per B.H.P. hour | 8.69 per B.H.P. hour | 626 | Prof. Gutermuth, Darmstadt | Tandem compound, double superheat, chimney cylinder jacketing. |
| 5 | 1910 | Wolf | 520 | 1.02 per B.H.P. hour | 8.70 per B.H.P. hour | 649 | Brussels Exposition, Test Committee | Cross compound, double superheat, steam cylinder jacketing. |
| 6 | 1912 | Wolf | 300 | .................... | 8.9 per B.H.P. hour | 644 | Prof. Doerfel, Prague | Cross compound, uniflow cylinder, single superheat. |
| 7 | 1913 | Buckeye Engine Co. | 169 | 1.08 per I.H.P. hour | 9.2 per I.H.P. hour | 588 | Geo. Cooper, Buckeye Eng. Co., Salem, O. | Tandem compound, double superheat, chimney cylinder jacketing. |
| 8 | 1909 | Lanz | 120 | 0.805 per B.H.P. hour | 7.41 per B.H.P. hour | ...... | Prof. Grossmann, Karlsruhe | Cross compound, "ventil" valve gear. |
| 9 | 1908 | Lanz | 249 | 1.1 per B.H.P. hour | 9.74 per B.H.P. hour | 680 | Prof. Schröter, Munich | Cross compound, "ventil" valve gear. |
| 10 | 1910 | Lanz | 1105 | 1.08 per B.H.P. hour | 9.65 per B.H.P. hour | 676 | Brussels Exposition, Test Committee | Cross compound, "ventil" valve gear. |

* World's record.




1. Forty horse-power tandem compound Wolf "lokomobile" or superheated steam unit with double superheat and high-pressure cylinder jacketed in the chimney uptake. 2 and 3. Sectional elevation and plan of same. 4. World's record Wolf lokomobile, 150 horse-power 0.72 pound of coal per brake horse-power-hour consumption. Double superheat and both cylinders jacketed in smoke hood. 5. Cross compound 600 horse-power Wolf lokomobile at Brussels Exposition. Double superheat and both cylinders jacketed in the steam dome. 6. "The Buckeyemobile" or first American superheated steam unit, virtually a copy of No. 4. 7. The Wolf uniflow cylinder compound condensing lokomobile, the latest advance in superheated steam units, 300 to 800 horse-power. 8. High-pressure and low-pressure cylinder card from No. 7. 9. The first American superheated steam unit with Alden dynamometer. 10. Diagram showing course of steam through the Wolf uniflow high and low-pressure cylinders.

**The superheated steam unit.**

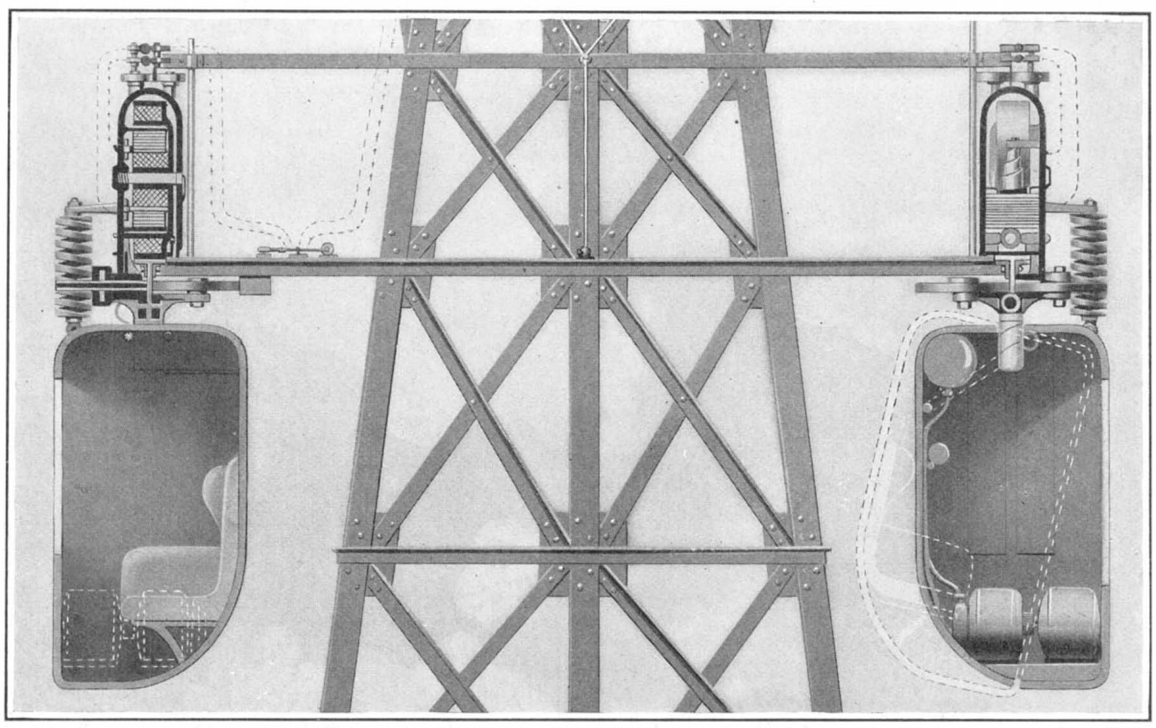
# An Aerial Monorail

## Mähl System for High Speed Suspended Electrical Trains

AN outline of a new system of high speed monorail trains moved by electricity was one of the interesting features recently discussed in Paris, as the constant desire for greater speed in trains has been uppermost in the minds of railway engineers for a long time. It seems evident that the limit by existing methods has practically been reached, and if the speeds of to-day are to be surpassed methods based on different principles must be adopted. One hundred and twenty miles an hour has already been attained in experiments with electric traction (Zossen in 1902) but this rate is clearly incompatible with two tracks resting on the earth and following ordinary railway construction. On curves especially great strains are developed which, even with present speeds, result in breaks and derailments; and with higher speeds these would be more probable, and the resulting accidents more disastrous even than those of to-day.

It is much more philosophical to seek the development of high speeds through the elevated monorail mounted on pillars, for here high speed is really possible with light, articulated cars suspended from flexible running gear, the many wheels of which would serve to distribute the weight along the rail. The applications of such a principle are by no means confined to places where speed is the desideratum. Such railways are already used for mines and quarries, for factories and for rope railways carrying passengers, as at Chamonix and other places in Switzerland, and are not without value for regular traffic, as for example the Barmen-Elberfeld road in Rhenish Prussia, the eight miles of which have been in operation since 1901.

It is a road of this kind that is suggested by Mähl, an engineer of Paris who is well known for his studies in the transmission of power, who has just submitted to the Minister of Public Works detail plans for trains with speeds up to one hundred and eighty miles an hour. In the Mähl system, the track, whether single or double, is from twenty to twenty-five feet above the ground, with towers or pylons, and the familiar suspension-bridge catenary cables between them. The conveyances are to be long, light, articulated cars, the joints affording them the ability to conform to the curves in the line. There will be no grade crossings nor tunnels, and the difficulties that are inherent in present road-bed construction and current systems of running will be avoided.



**Details of construction of a monorail line, showing section of cars, method of constructing tracks, and of suspending and driving the cars.**

At the left is seen the motor and switches controlling the current; at the right is the braking apparatus. The large spiral springs control the swing of the car under the influence of centrifugal force.

The plans consider curves of a minimum radius of six-tenths of a mile and grades up to five per cent. The pylons are square at the base and of dimensions varying according to the needs. The longitudinal vertical section of these is triangular, the average height to the top being about fifty feet, and the transverse vertical section is hour-glass shaped, the upper portion serving to hold and spread the cables and furnish vertical support from above to the rails, while the cars hang in the neck of the hour-glass, or the angle formed by the upper and lower sections of the tower.

The tower must be well anchored on hard pan or rock, without depending on surface stability; and it will be practicable to use rocky gorges without much consideration of surface levels; even the beds of streams will furnish the route for such a railway. The distribution of the towers may be varied to suit conditions, but with an average distance between them of about one hundred and fifty to two hundred feet. The sag of the cables is about twenty-five feet, and the rails will be supported by them at such a height that the cars extending ten feet below them will leave fifteen or twenty feet in the clear.

The cars will be composed of tractor elements and accessories and vehicle elements. The former will include the motors which are independent and tandem on the rail, at intervals of a little more than a yard. The cars are about one hundred and fifty feet long and one meter wide, generally rectangular in shape with the inner lower corner rounded, and fitted with but one row of seats, back to the inner wall. The cars will have some lateral play, swinging out of the perpendicular in one direction or the other on rounding curves. The articulation is a minor feature designed to adapt the cars more closely to the curves; but there is only about a quarter of an inch play at each joint, an amount that will not be perceptible to the passengers.

The track will be divided into sections of five kilometers each (3 miles) and a train will always have automatically two dead sections behind it forming a perfect block system and avoiding collisions. On entering a section the train automatically cuts off the current from the section just quitted, and turns it on to the third section in the rear. The intermediate sections will be left in its currentless condition. There are thus always live sections ahead for the train with clear track, but lack of current and automatic braking if there is a train within three sections. The projector asserts that it will be safe to run under such conditions with only a two minute headway.

Switching is to be done by means of moving sections of rail that will take a car and provision is made for removing obstructions on the rail or snow by means of a plow on the forward motor hood. The plans call for ties and braces to support the rail, completing a light but strong structure competent to carry not only the weight of the train but to withstand the strains due to wind pressure and the centrifugal force that the train will exert at curves.

The monorails are to be T pattern, and in the spans between the towers they may be joined by fish-plates or welded. Interlocking joints will prevent all shocks and consequent injury to the rails, and at the towers there will be provisions for expansion.

The motors will be of special pattern, the stators being fastened to the frame of the car while the motor wheels will be without flanges. Friction rollers below the rail will guard against accidents of derailment. For heavy grades provision is made for donkey-motors, taking current from a super-rail, which will run above the top of the car and make flying connection while the car is slowing up at the grade. The motor will precede the car slowing gradually till it has the same speed and will then by electrical action link itself to the car. At the top of the grade the current of the donkey will be cut off automatically, it will uncouple itself and then be ready to return for another tow.

The cars are to be fish-shaped in front and similarly rounded at the rear, and the mechanician in his cab in the forward compartment is surrounded by devices of report and control. One of these matters is lubrication. High speeds are apt to cause heating of bearings, and it is proposed to enclose in every axle a thermostat which will give notice to the mechanician of any undue rise in temperature. There is an elaborate plant for lubricating, a pump, pipes to each bearing, etc., so that, as in some lathe or automobile processes, there is a constantly flowing stream of oil. The mechanician will have at hand the means of increasing the flow at the bearing which sends warning and thus bridge the difficulty.

In addition to the care expended on a smooth and continuous rail the provision of shock absorbers is suggested, and springs are provided to reduce to a minimum the swing from centrifugal force, which will be merely a sway of small amplitude even at high speeds. The brakes are springs released by electro-magnetic action, and once applied they cannot be released until the train has been brought to a stop.

As to the cost, the French estimate, which can hardly apply to this country, is twenty thousand dollars for a car fifty meters in length weighing fifty-five tons with a carrying capacity of two hundred. With the passengers the weight on the rail will therefore be not far from a ton and one-half to a meter. For such weights, and to sustain the other strains the cost of construction of the way, including electrical instalment, according to the estimate, is between eighty and ninety thousand dollars a mile. This does not include, however, the power house and its sources of energy.

Some of the computations of strains and other items may be of interest. For the catenary suspension of such a railway as has been discussed four cables of a diameter of 50 millimeters each (2 inches) will be ample. The centrifugal effect, with two trains on the tracks, referred to the base of the towers is figured at 8 kilogrammes per square millimeter, while it is 6 kilogrammes on the rails themselves. So far as wind pressure on the cables and structure is concerned, the amount is figured to be only about one third of that of the centrifugal force under usual conditions of weather, while that on the train is perhaps double the value of the centrifugal force, these strains being well within the strength of usual constructions. The resistance of the air rises very rapidly with the speed, being 1,230 foot-pounds for 75 kilometers an hour; 10,000 for 150 kilometers, and 80,000 foot-pounds for 300 kilometers. The energy required for running on a level rising rapidly with the speed, being for level stretches 29 kilowatts and 223 kilowatts, respectively, for the three speeds. On grades of 50 millimeters to the meter the corresponding kilowatt figures are 745, 1,500, and 3,080.

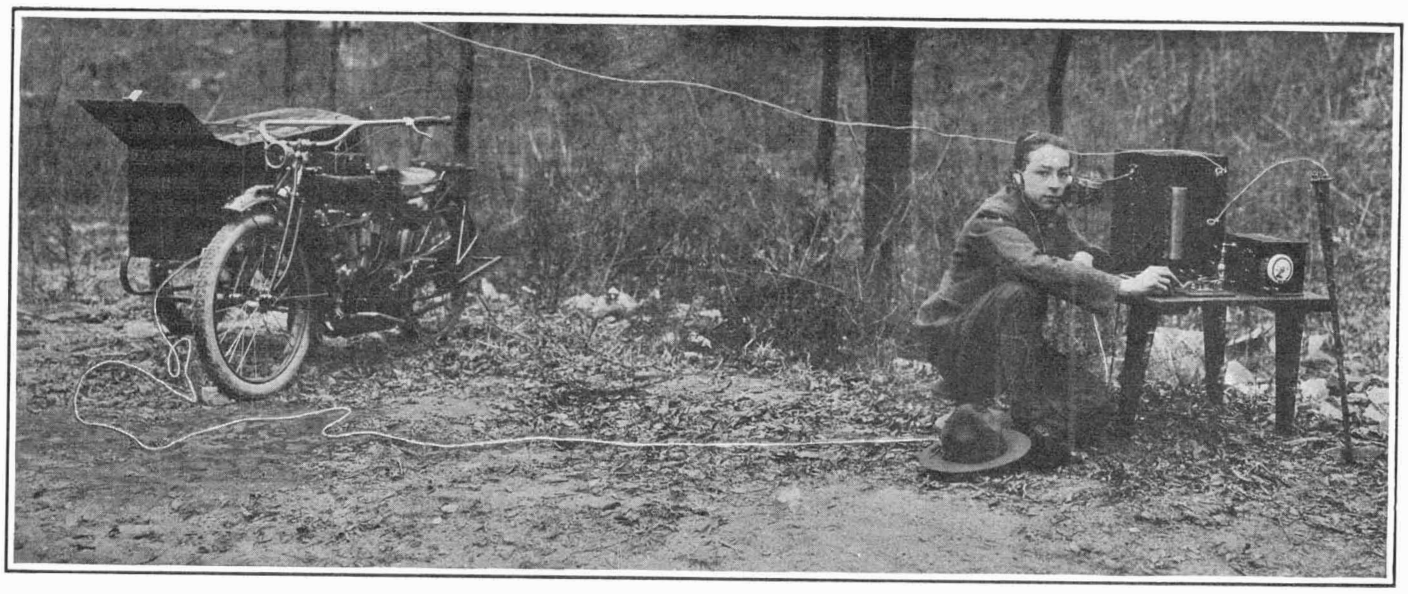
### The Detoxication of Coffee

PERSONS with a sensitive stomach are affected not so much by caffeine as by the products formed in roasting the coffee. The effects in such cases are not nervous, but digestive, and they may be so pronounced that the person affected cannot drink coffee at all.

The object of recent experiments was to eliminate from coffee the harmful products of roasting, without, at the same time, removing the caffeine, to which the coffee owes its stimulating effect. A procedure is used by means of which the coffee bean is covered, during the process of roasting, with certain substances, such as for instance, kaolin or china clay, which absorbs the poisonous products. The clay is applied either in form of a paste, or is made to adhere to the beans by means of the moisture which escapes when they are roasted. By means of its capillary qualities, the clay absorbs the products of roasting, the oils and resins formed being thus eliminated from the surface and the upper stratum of the coffee bean.

Prof. Görbing made a series of practical tests with coffee detoxicated in this manner. He found that seventeen persons who were unable to take ordinary coffee, were not made to suffer the slightest effects when they drank his coffee. With nine other persons detoxicated coffee agreed better than ordinary coffee, and in one case only was there no difference between the two.

Radio outfit in a side car.



Field radio telegraph and telephone station using a motorcycle power plant.

## Radio Telephone and Telegraph Equipment on a Motorcycle

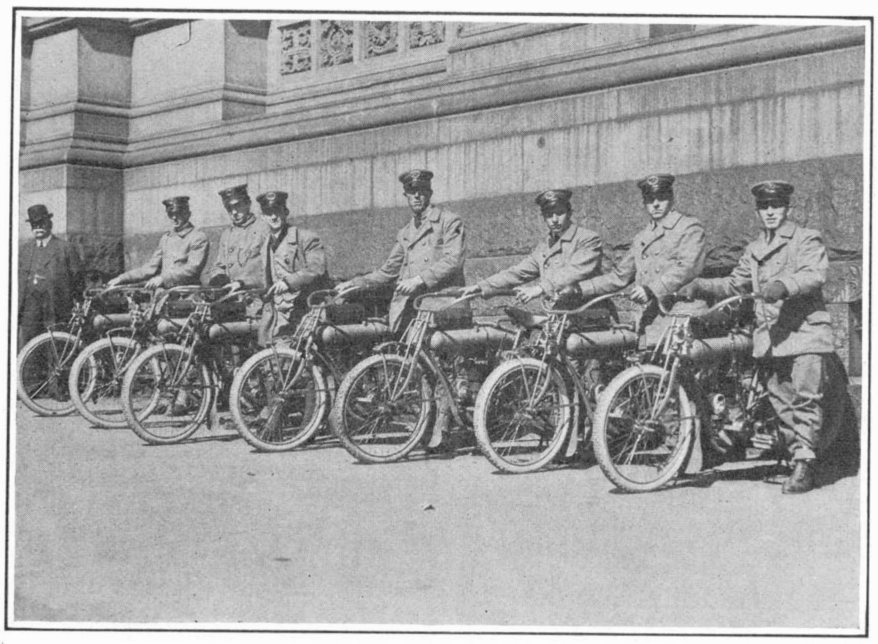
A MOTORCYCLE radio telephone and telegraph set has recently been devised by a New York inventor for use by armies on the march or in the field. The equipment is contained in a metal side car attached to the motorcycle. The transmitting power is approximately one kilowatt with a resultant radius for the wireless telegraph of eighty to one hundred miles and about half that distance for the radio telephone.

Current is supplied to the telephone or telegraph by a high voltage direct current generator connected directly to an independent motorcycle engine contained within the sidecar. In this connection mention should be made of the fact that the wireless equipment comprises a complete unit entirely independent of the motorcycle. It can be readily detached and pushed by hand or loaded upon a wagon and transported over rough ground. An extra wheel is provided, which can be attached to either hub of the side car or to the front or rear of the motorcycle.

The antenna is supported by a light weight metal mast of tubular construction. The form is telescopic, so that the mast when collapsed can be easily strapped out of the way on the side of the car.

## Motorcycle Mail Delivery

THE Brooklyn Post Office is trying an experiment in the handling of special delivery mail. A letter or parcel bearing a special delivery stamp travels no faster than the rest of the mail, but on arriving at the post office station of its destination it must be delivered immediately. Where there are but few letters to be delivered considerable expense is involved if they must be taken out without delay by the usual car. Evidently a lighter vehicle would do equally as well, and so in Brooklyn a test of motorcycle delivery is being made. So far three of the twenty-two stations have motorcycle carriers. The machines are bought by the men and operated at their own expense. They are paid for their services at the rate of eight cents for each letter or parcel delivered. This service has only just been installed, and it is impossible at this early date to judge of its success.



Motorcycle mail delivery.

**State Must Pay for Highway Accident.**—A decision of great importance has been handed down by the New York Supreme Court in the case of a garage owner, whose car was wrecked upon a public highway, because the laborers on the road had left an iron spike on the side of the road, which spike caused the garage owner's automobile to overturn. The court held broadly that "any State that undertakes to 'maintain' roads within its boundaries for the traffic of vehicles, thereby automatically assumes all responsibility for damages and losses which may be sustained by people using such roads."

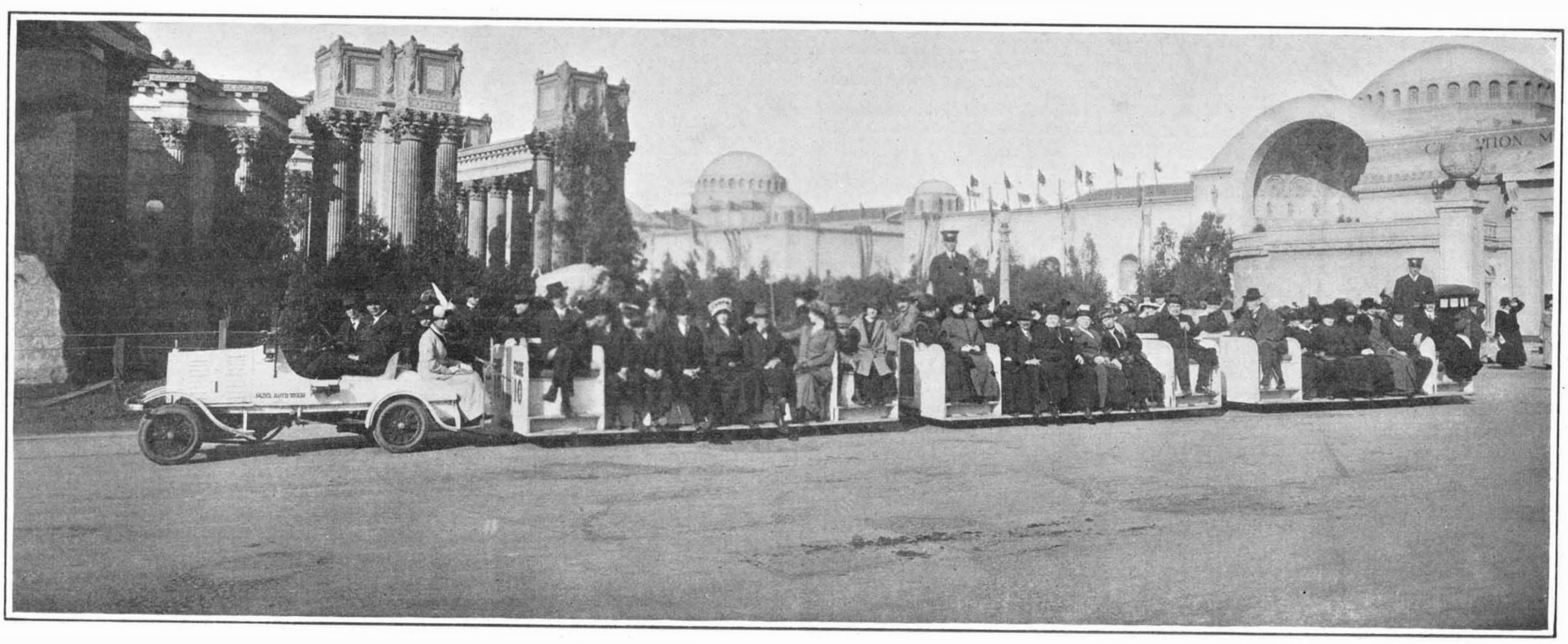
## Motor Tractor Trains at the Exposition

ONE of the notable features of the Panama-Pacific Exposition is the system of sight-seeing automobile trains that skim about beautiful Jewel City, conveying thousands of exposition visitors over the extensive grounds, and affording them a complete and comprehensive view of the great fair in its exterior aspect. These midget trains were invented by R. B. Fageol of Oakland, California, who recognized the need of an efficient, economical and popular solution of the transportation problem within the grounds of the Exposition.

In detail each train consists of a special miniature motor tractor and two specially designed trailers or cars resembling a double settee with the conductor's aisle in the center. The braking system consists of a shoe connected midway in the drawbar, which is forced downward when the motion of the train is slackened, the action being automatic and in unison with the tractor, making it absolutely safe in crowds. The system is an entirely new invention which successfully solves a hitherto perplexing problem.

The whole car is but one step off the ground, running on four invisible wheels, all controlled by a drawbar connection to the tractor in such a way that the two cars follow in exactly the same tracks as the tractor when rounding a turn in the road. This feature eliminates any cutting off on turns or crowding of people off the road. Each train seats forty people comfortably.

**An Electrically Controlled Shock Absorber.**—In patent No. 1,123,404 W. T. Sears of Philadelphia, Pa., provides in connection with a shock absorber, which can be employed in connection with automobiles and the like, means by which variable resistance may be secured in a positive and certain manner through the aid of electro-magnets of any suitable form by which he can automatically magnetically vary the frictional or other checking effect applied to the relatively movable members of the shock absorber.



Sight-seeing automobile train, a popular feature of the Panama-Pacific International Exposition.

## Notes for Inventors

**Who Will Devise a Non-mirror Show Window?**—A merchant tells the writer of the desirability of some means for effectively preventing the mirror effect in show windows, the effect we all notice in passing such a window in which our image is reflected and the contents of the window are shut out of view. Naturally the shopkeeper who works for a display in his window resents its not being seen. Some attempts we are told have been made, but there seems to be room for a simple effective remedy for the suggested difficulty.

**Synchronizes Co-operative Musical Instrument.**—The Aeolian Company of New York, as assignee of Samuel S. Waters of Washington, D. C., has secured patent No. 1,128,923 in which there is a main musical instrument having a perforated sheet which wholly controls, through suitable means, the operation of the record of an auxiliary musical instrument so the two instruments will operate in perfect time with each other.

**Wrapper Unwraps the Cigar.**—Milton Wertheimer of Baltimore, Md., in patent No. 1,128,828 provides a wrapped cigar with the end of the wrapper beyond those of the cigar twisted in the same direction so that by pulling its twisted ends the wrapper will unwind or open to expose the cigar.

**A Piano Without Strings.**—In patent No. 1,128,112 issued to J. C. Deagan of Chicago, Ill., is presented what is termed a piano without strings. The vibrating body is in the nature of a xylophone made of wood, metal or other vibrating material which may be set into vibration by any suitable means such as a hammer and the sound waves are modified or influenced by resonating tubes shown one within the other with their sound receiving ends toward the vibrating bar.

**Your Hands and the Golf Club.**—In playing golf a careful player will consume considerable time in properly positioning the club in his hands to bring it in proper position with respect to the ball. To facilitate this A. W. Hayford of Swampscott, Mass., has patented, No. 1,126,208, a golf club in the grip of which is embedded a positioning or aligning device running lengthwise of the shaft and projecting from it in such manner as to serve as a gage in gripping the club.

**Chairman Oldfield Retires from Patent Committee.**—On March 4th, the Hon. W. A. Oldfield, chairman of the House of Representatives' Committee on Patents, retired from that committee, as at that time he went on the Ways and Means Committee and retired from all other committees under the rule of the House. He has been an active energetic chairman, ever ready to urge with all his might that which he thought should be supported by his committee. He has also shown a warm interest in the Patent Office and only a few weeks ago delivered an address in the Patent Office building to the examining corps of that office. It is likely that he will be succeeded in the chairmanship by the Hon. Martin A. Morrison of Indiana, who will be the senior Democratic member of the committee.

**A Ticket Holder Wanted.**—A retail clothing man says that the trade needs a ticket holder for holding the price and lot tickets to a coat or other garment, which holder can be easily applied to and removed from the garment and will permit its ticket to be removed and another inserted, all without mutilation of or other injury to the garment.

**Bill Lost After Passing Congress.**—The Patent Office reorganization bill after it had passed both houses of Congress was, in some way, lost before it was signed by the President, and therefore failed of becoming a law, since it was not approved before noon on March 4th. To become a law it must be re-introduced and advanced anew in the Sixty-fourth Congress. As the law was only expected to become effective in July, 1916, the incident may not affect the operation of the Patent Office. The bill provided for two additional examiners-in-chief, one additional law examiner and for eighty-six assistant examiners in each of the four grades. When it becomes a law it will result in promotions all along the line of the examining corps. How the bill, after passing the Senate, was lost and failed to reach the President for signature, is still a mystery.

**Patent Office Assignment Records.**—We have in these columns repeatedly referred to the assignment records of patents. In his report of January 30th, 1915, to Congress, Commissioner Ewing refers to the frequent necessity of ascertaining what patents are owned by a particular individual firm or corporation and goes on to say that there is no authentic manner at present in which such search can be made except in each of the volumes wherein are recorded assignments and the data of the application, where they are indexed from assignor to assignee. Mr. Ewing in the report urges the importance of establishing and maintaining a consolidated assignee index and states that requests are frequently made for such an authentic, verified, and checked index, from which a reliable search may be made to ascertain what patents are owned by given corporations, firms, or individuals. To perform this service it is believed that three more index clerks will be required in addition to those now employed in the Assignment Division, and for the indexing covering the past 17 years five or six additional clerks will probably be needed to bring up its arrearage within a reasonable time. The Commissioner will submit at an early date to Congress a request for authority to establish this index and a request for additional clerks for this purpose.

**A Classification Index for the Official Gazette.**—Beginning with the issue of Tuesday, April 6th, the Patent Office *Gazette* will for the first time print a classification index; that is to say, an index of the different classes with the numbers of the patents of the respective issues. This will enable a subscriber to the *Gazette* to determine without any trouble all the patents in any issue in any class in which he may be particularly interested.

**Glasses for Rainy-day Golf.**—President Wilson who is an ardent golfer and also dependent on his eye-glasses is reported as saying that he cannot play the game in the rain because of the accumulation of moisture on his glasses, which leads to the suggestion that specially devised glasses or some treatment of the ordinary lens may solve the problem.

**Congress and the Steam Engine.**—The Hon. J. Hampton Moore of Pennsylvania, in asking the privilege of inserting in the *Congressional Record* the address of Mrs. Ben Johnson, the wife of a representative from Kentucky, which request was granted by the House, pays a high tribute to Mrs. Johnson's painstaking care in carrying the story from Fitch's birth in South Windsor, Conn., to his death in July, 1798, at Bardstown, Ky. Mrs. Johnson states her purpose as being to secure a suitable marking for Fitch's grave. She quotes numerous letters and other documents on file in the Congressional Library to show a conception and completion of the steamboat by Mr. Fitch, probably 15 or 20 years prior to the initial trip in August, 1807, of Robert Fulton's "Clermont" on the Hudson River. Those having an especial interest in the matter will find the address printed in full in the *Congressional Record* of March 2d, 1915.

**Will Your Watch Stand the Test?**—We now have in this country an opportunity to secure an official standard of that commodity sometimes compared to money in the often repeated "time is money." The Bureau of Standards, the Official Measurer of the United States, undertakes for a fixed fee ranging from 50 cents to five dollars to report on and certify as to pocket watches. The most elaborate test, known as Class A, involves the running of the watch for 54 days in a series of periods in various positions and at different temperatures. The subject is treated at length in the Bureau of Standards Circular No. 51, which includes treatises on the handling of a watch, its winding and the manner in which it is carried, and will be found of much interest to those who appreciate a timepiece accurate to the highest degree.

## The Principles of Radio-telephony

(*Concluded from page 286.*)

distances when it would be suitably modulated by the voice-waves.

Modulation of the wave-producing energy has been one of the most difficult problems of radio-telephony, and is not yet completely satisfactory. For long-distance radio-telephony current in the aerial-wire systems must be as large as 10 or 15 amperes or even more, whereas the microphone transmitters used in ordinary wire work never need to carry more than about one quarter of an ampere. Thus, it became necessary to devise and develop special water-cooled transmitters and microphonic relays for large currents, if full use were to be made of the radio-frequency alternator. This branch of the problem was among the first attacked, and there were produced instruments by the use of which wireless telephony was made a fact over twelve miles during 1906 and over two hundred miles, from Brant Rock, Mass., to Jamaica, N. Y., in 1907. The modulating instrument used in these long distance tests was a special type of differential telephone relay or amplifier, which not only made it possible for the voice to control relatively large amounts of wave energy, but also permitted the interconnection of wire and wireless telephones. By its use a person at his home could speak by wire to another person at some distant point on a second telephone line, an intermediate part of the talking circuit being provided by radio. Thus, the radio telephone can be used to link together existing exchange systems of wire telephones, and subscribers may from their own instruments talk with passengers aboard ships at sea or with others who would ordinarily be isolated because of the lack of through line connection.

Although radio-telephony has been the subject of research and invention by many investigators, and although a large number of devices for production and modulation of radiant electromagnetic waves have been brought forth in the past fourteen years, there has been no departure from the fundamental principles outlined above. The fact that telephony by "wireless" has remained almost purely experimental so long after its inception and first successful practice may be explained not only by a lack of confidence in its present commercial value, but also by the blindness with which many of its practical exponents clung to the use of unreliable instruments of types which should have been discarded long ago.

## The Superheated Steam Unit

(*Concluded from page 291.*)

slide-valve engines for thirty years, is not permitted, nearly all the steam having escaped to the low-pressure receiver and cylinder. Here it expands against the low-pressure piston, escaping to the condenser at the end of the stroke by a set of central ports arranged around the circumference of the cylinder at its center. Of course, the length of cylinder and piston is long enough in comparison to the stroke to allow these central ports to be covered by the piston, except at the end of the stroke. In other words, the thickness of the piston equals the length of the central ports.

This in brief is the construction of a compound uniflow engine as applied to the lokomobile or superheated steam unit. This combination of the two features in one engine is followed by a number of interesting corollaries. Cylinder jacketing now becomes needless, so that the cylinders are brought out in the open instead of being belted with a steam dome or cased in the smoke-box hood. The uniflow distribution of the steam prohibits the use of a superheater between high and low-pressure cylinders, so this is omitted. A radical change is also made in the high-pressure superheater. In order to avoid the long spiral coil of superheater pipe (in large-sized engines exceeding three hundred feet of 3-inch pipe) the superheaters for the uniflow type have two wrought iron headers the length of the smoke box; these headers being joined by many double-





## INQUIRIES

*Inquiry No. 9431.* Wanted to purchase a mold for shaping and piercing beads made of rose leaf of the consistency of dough.

*Inquiry No. 9439.* Wanted the name and address of a manufacturer of a knitting machine which was on the market some years ago. The name of the machine was the Bickford Machine. It was a hand knitting machine, weighing about 15 pounds.

*Inquiry No. 9440.* Wanted the name and address of a concern selling Dr. Young's E-Z Sanitary Belt.

**spiral coils of small pipe in multiple.**

**These various simplifications enabled** the Wolf people to put out a line of large uniflow lokomobiles, the smallest listed being 300 horse-power. The published floor areas of these sizes will be of interest by comparison with ordinary steam plants of the same horse-power, as they represent very fairly the average floor areas of lokomobile plants: For the 300 horse-power, 9 feet 5 inches wide by 22 feet long; 500 horse-power, 11 feet 9 inches wide by 27 feet 9 inches long; 600 horse-power size, 12 feet 9 inches wide by 30 feet 3 inches long; a good deal smaller than our boiler plants alone for the same horse-powers.

The reason is not far to seek. We rate our boilers on 30 pounds of steam evaporated per horse-power-hour; a lokomobile only uses 7 to 10 pounds, hence the much smaller boiler, even including the superheater space. And, incidentally, all the usual boiler losses such as twenty per cent of the coal pile going up the chimney as waste, boiler feed pump charges, radiation, etc., are reduced in a like ratio per horse-power produced.

Test 7 is of the American "Buckeye-mobile." This engine is, in effect, a copy of the Wolf tandem compound with double superheat, and both cylinders jacketed in the smoke hood; a few mechanical improvements have been added, such as a trolley rail for running out both superheaters for prompt and easy inspection of the superheaters and the gasket joint and nuts of the forward tube sheet. There is, further, a new piston valve which does not have to have its rings sprung on; and a new type of stuffing box for superheated steam. (Engine shown in Figs. 6 and 9.)

But the main feature of interest to Americans is the fact that this machine is American-built in every feature throughout, with United States Standard nuts, bolts, rivets, shop measurements, tubes, pipes, and pipe fittings. Only those who have had to use a metric-system-built engine in America can appreciate the enormous difficulties of replacing any lost or broken metric fitting in our machine shops. And, from discussions that I had abroad with the German manufacturers, it will be some time before they establish branch factories in this country manufacturing their lokomobiles on American standard measurements. They have enough to do to meet the demand where the metric system holds sway, both the Wolf and Lanz companies building an average of 2,000 lokomobiles each per year without meeting the present European demand.

While these blue-ribbon tests are all very fine, the writer felt that what the American public wanted to know was what the lokomobile could do in daily work in the average mill and industrial plant; what of the 60,000 already built; were they a success, and were the owners ordering more of them? Could the lokomobile be depended upon to show 10 pounds of steam and 1.5 pounds of coal to the brake horse-power in yearly coal account? How about its reliability, its lubrication, and attendance?

While these questions had been partly answered by the lokomobiles I had seen in France and Belgium, a trip to Germany, the home of the lokomobile, would furnish conclusive data, so I arranged for a tour throughout industrial Germany—Berlin, Magdeburg, Dresden, Mannheim, Cologne, Düsseldorf, Duisburg—studying the lokomobile at first hand; its daily coal records, its details of construction, maintenance, operation, every fact of practical importance that could be gleaned.

The task was not as easy as it would be in America. Managers of factories, industrial plants, etc., will not allow a visiting engineer to inspect their power plants to "get a line on" certain engines and boilers, as is cheerfully granted anywhere in America. They will allow a stranger in, however, as a special favor to the engine builder's sales representative, and both the Wolf and Lanz companies were very generous about detailing men to take me to visit various establishments where lokomobiles furnished the motive power. I saw all sizes and types of lokomobiles **in every conceivable industry, from elec-**

tric light and power service to candy making. In general the following facts may be accepted as common practice with all of them: The daily coal account in all sizes from 40 to 500 horse-power-hours shows an average of 1.3 pounds of coal per brake horse-power hour, or 2.5 pounds of lignite (5,000 British thermal units). Up to 250 horse-power one man suffices to both fire and run the lokomobile, and, as both engine and boiler *must* be kept clean (for the sake of the engine bearings); both are handsomely finished and decorated, and are kept polished and wiped down, no soot, ash, scale or dirt being tolerated. The class of attendant in charge is about the grade of a licensed engineer that we pay $3.50 per diem for, able to give the engine more intelligent care and the boiler better firing than the average fireman that we employ. As a rule some sort of mechanical stoker was used, and low-grade fuels, such as lignite, peat, straw, sawdust, etc., were easily handled mechanically (also crude oil), the small lokomobile grate being peculiarly adapted to such apparatus. The steam jet for cleaning off superheaters is almost invariably operated once in 24 hours, sometimes twice. Removable furnace and tubes are withdrawn once a year for a thorough cleaning of the shell and tubes from scale. This long time between cleaning is also partly due to the excellent water softening plants in use all over Germany. About an equal quantity of cylinder and machine oil is used per day. The cylinder lubricator oil used is guaranteed at 350 deg. Cent. and some standard form of mechanical pressure feed apparatus supplies it to the engine.

I also visited the works of R. Wolf at Magdeburg and Heinrich Lanz at Mannheim, saw the construction details of lokomobile building and talked with them as to their plans for introducing the lokomobile into America. It is impossible for us to use them as made abroad because of the metric system fittings used throughout. Moreover, it will take us as a nation a good while to realize that here is a good, economical prime-mover, representing millions of horse-power in Europe and her trade dependencies, yet whose qualities are hardly known among our people as yet. The Germans are in no hurry to invade us at present. We have one live engine company making them already, in a large number of sizes, and fitting our standard dynamo ratings. When our engineers do get acquainted with the lokomobile it will take all this company's output, plus what the Germans will be able to send us, specially made for export trade and equipped with United States standard fittings, to supply the demand.

### Chestnut Blight Poisoning

THE newspapers, as well as some of the scientific journals, have recently reported several cases of illness and a few deaths supposed to have been due to eating chestnuts from trees affected with the chestnut blight. This subject has been investigated independently by G. P. Clinton, botanist of the Connecticut agricultural experiment station, and by C. D. Marsh, of the United States Department of Agriculture, who reports his results in the *Journal* of the American Medical Association. In both cases the results were substantially negative. Dr. Clinton declares that "there was no evidence that the blight fungus or other fungi were directly connected with the sickness, since experimental feeding of white rats with these fungi failed to produce any injurious effects. Small amounts of pure cultures of the blight were also eaten by the writer without ill effect." He suggests that trees might be so injured by the blight as to produce a greater proportion than usual of nuts not perfectly matured, and that these might possibly contain some self-produced poisonous principle, though this is not considered probable. Prof. Marsh reports to much the same effect. He says: "The symptoms attributed to eating blighted chestnuts were in all cases such as might be produced in some persons by chestnuts from healthy trees."

## REPRINTING BACK NUMBERS OF THE

# Scientific American Supplement

## TO BE DISCONTINUED

### *Of Importance to Librarians*

The Scientific American Supplement is a unique periodical.

Established in 1876 to describe the exhibits of the Philadelphia International Exposition, it proved so successful that the publishers decided to continue it on broader lines.

Whenever a Tyndall, a Huxley, a Helmholtz, a Pasteur, a Liebig, a Crookes or any other prince of science rose in the learned societies of Europe and announced some new epoch-making discovery of his, his own words appeared in the Scientific American Supplement. The technical papers read by engineers before societies in America—papers too recondite and too long for more popular periodicals—have been given a place in the Scientific American Supplement. Americans who could not read foreign languages found in the pages of the Scientific American Supplement, the utterances of great European physicists and chemists translated into English.

So, in the course of time, the Scientific American Supplement has become a kind of encyclopedia of original scientific sources. It figures over and over again in the footnotes to monographs and scientific treatises; it has played its part in research of all kinds.

As remarkable as the publication itself is the method by which it has been made accessible to the general public. **Every number of the Scientific American Supplement from 1876 to 1915 has been kept in print. What is more, the numbers of 1876 have been sold for 10 cents just as if they were published today.** And this despite the fact that publishers of newspapers and periodicals often charge several hundred per cent more for back numbers than for new ones.

The Scientific American Supplement will continue to print the papers of great scientists and engineers as it has in the past. **But the policy of reprinting back numbers will be discontinued.**

For a few weeks only we shall be able to furnish all the single numbers of the Scientific American Supplement or bound volumes.

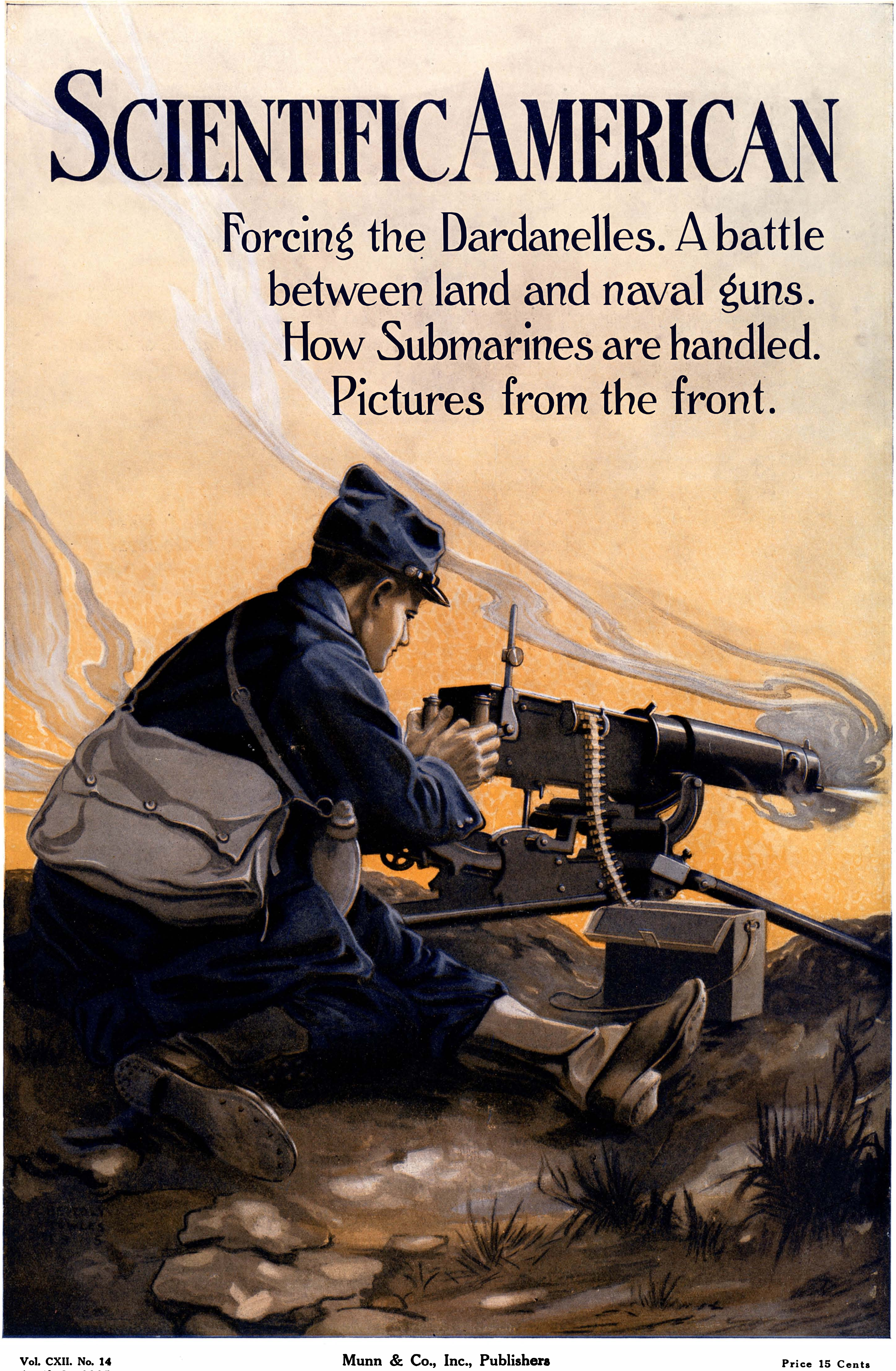
This announcement is made for the benefit of libraries in which complete sets of the Scientific American Supplement are not to be found, and for those interested in science who feel a genuine need for an encyclopedia of science of the most diversified kind.

We will supply, free of charge, on request, copies of the Scientific American Supplement Catalogue, in which all the papers that have been printed in the Supplement since 1876 are indexed. This catalogue will not be published in the future.

*Order back numbers or bound volumes of the Scientific American Supplement now either from your bookseller or directly from the publishers.*

**MUNN & CO., Inc., *Publishers***

**233 Broadway New York**




Vol. CXII. No. 14
April 3, 1915

Munn & Co., Inc., Publishers
New York, N. Y.

Price 15 Cents
$3.00 A Year

## Ask the Steel Man

What manufacturers put the best steel in their cars?

## Ask the Accessory Man

What manufacturers put the best accessories in their cars?

## Ask the Banker

What automobile firms have made good financially and are able to back up their cars?

## Ask the Automobile Dealer

What are the three best automobiles in the class from $1400 to $2400?

## Ask the Owner

How he is satisfied with his Chalmers Six—ask him particularly about its *monthly cost* for up-keep?

## And the Answers

You will find more than substantiated by going to the nearest Chalmers dealer and there examining the Chalmers. In this way you will be *buying* a car, and not being *sold* one.

CHALMERS · MOTOR · CO
Detroit, Mich. U.S.A.

*Quality First*

**Chalmers Models**

*New Six-40 at $1400*  *Light Six-48 at $1650*
*Master Six-54 at $2400*

Chalmers Motor Company, Detroit

**Let Your Next Car Be a Chalmers**

SEVENTY-FIRST YEAR

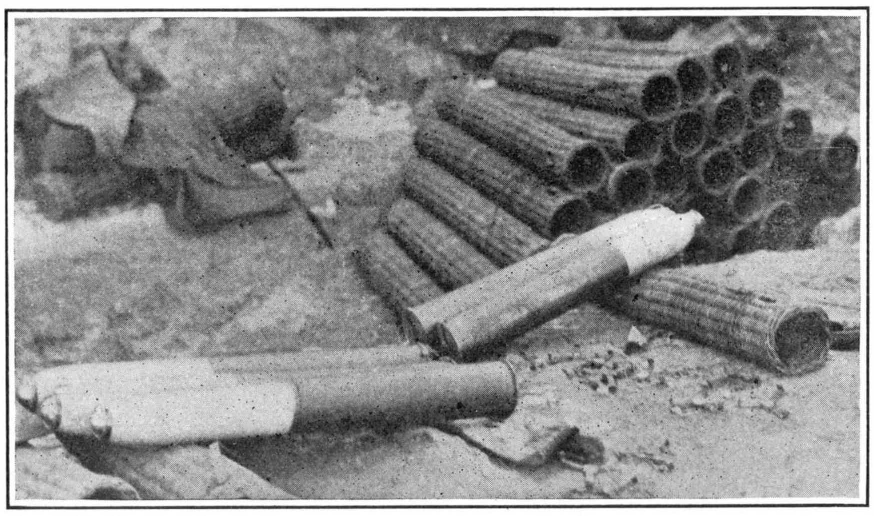
# SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

VOLUME CXII.
NUMBER 14.

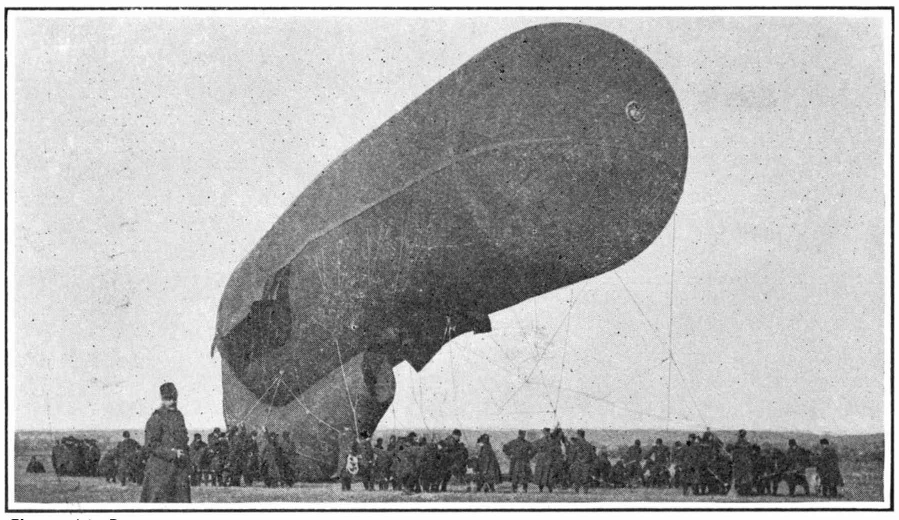
NEW YORK, APRIL 3, 1915

15 CENTS A COPY
$3.00 A YEAR



Copyright by International News Service

A pile of German 15-centimeter shells and the wicker casings used in transporting them.

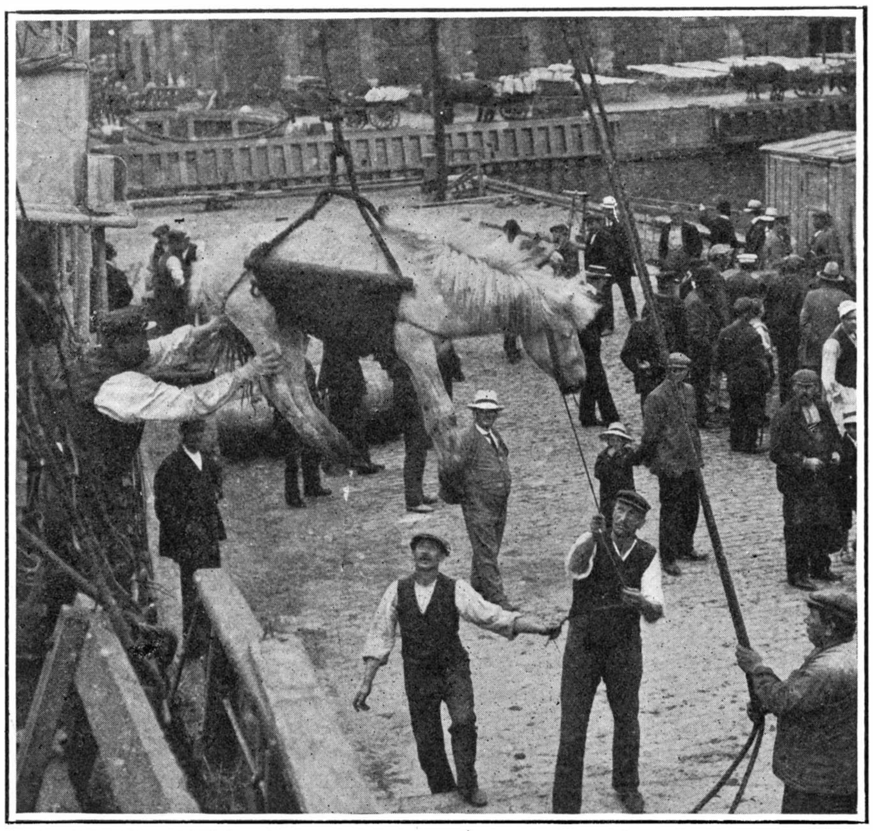


Photograph by Branger

A French kite balloon ready to ascend in order to make observations of the effect of artillery fire on the enemy.

Photograph by Underwood & Underwood

A British tommy cooking his dinner on a brazier in the trenches.



Photograph by Underwood & Underwood

Army horses are scarce. Little Icelandic ponies are imported in great numbers.

Copyright by International News Service

The broken-backed "L-3" of Germany's aerial fleet on Sanoe Island

This airship, a Zeppelin, while on a reconnoitering voyage, descended during a storm owing to a defect of its motor. The airship was lost, but the crew were saved. Immediately after the catastrophe the airship burst into flames. The captain declares that he set the Zeppelin on fire purposely "in order to prevent her from being blown further ashore and imperil its lives and the adjacent buildings." The crew had time to land their ammunition and bombs.

THE NEWEST PICTURES OF THE GREAT WAR

# SCIENTIFIC AMERICAN

**Founded 1845**

**NEW YORK, SATURDAY, APRIL 3, 1915**

Published by Munn & Co., Incorporated. Charles Allen Munn, President; Frederick Converse Beach, Secretary
Orson D. Munn, Treasurer
all at 233 Broadway, New York

Entered at the Post Office of New York, N. Y., as Second Class Matter
Entered as Second Class Matter at the Post Office Department, Canada.

Trade Mark Registered in the United States Patent Office




**Subscription Rates**

| | |
|---|---|
| Subscription one year | $3.00 |
| Postage prepaid in United States and possessions. Mexico, Cuba, and Panama | |
| Subscriptions for Foreign Countries, one year, postage prepaid, | 4.50 |
| Subscriptions for Canada, one year, postage prepaid | 3.75 |

**The Scientific American Publications**

| | |
|---|---|
| Scientific American (established 1845) per year. | $3.00 |
| Scientific American Supplement established 1876. " " | 5.00 |
| American Homes and Gardens " " | 3.00 |

The combined subscription rates and rates to foreign countries including Canada, will be furnished upon application.
Remit by postal or express money order, bank draft or check

**Munn & Co., Inc., 233 Broadway, New York**

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp* the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.


*The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.*

## The Battle-cruiser

CONGRESS has adjourned without making provision for the addition of any battle-cruisers to our Navy, an omission for which, in our opinion, the country may have to pay very dearly if hostilities should ever overtake us. The motive which has led the department to recommend the construction of battleships to the exclusion of battle-cruisers is the realization of the fact that the winning or losing of a campaign, other things being equal, depends upon the relative strength of the first fighting line of dreadnoughts of the two contending navies. It is claimed that whatever temporary advantage may be gained by battle-cruisers in scouting, harassing the enemy's shipping or bombarding seacoast cities, the issues of a war will be determined when battleship ranges up against battleship to fight it out to the death. The point of view is assumed that the battle-cruiser, because of its lighter armor, will not be able to lie in the front line—an assumption which, in view of the actions which have been already fought between battle-cruisers, seems to us to be rather doubtful. The steep angle of fall of the shell at the great ranges which promise to govern future fighting, has upset the theories of armor protection; for the few facts which have filtered through indicate that a large percentage of the hits are upon the deck and not upon the side armor, and a plunging fire of this character seems to wipe out to a not inconsiderable extent the advantage conferred by the heavier side armor carried by battleships. But even if it be granted that the battle-cruiser will not lie in the first line of battle, is the subordinate work for which her combination of high speed and heavy gun power render her so effective, of such minor importance that we can afford to dispense with this type altogether? Certainly the developments of the present war do not support this point of view.

Had Great Britain possessed no battle-cruisers, the armored cruisers of Von Spee might be ranging the high seas to-day, sinking merchant shipping and overtaking and crushing by superior gunfire the more lightly armed cruisers of the "Good Hope" and "Monmouth" type. The battle-cruisers of the German home fleet would be free to make a dash now and then across the North Sea, raiding coast towns and sinking any British armored and protected cruisers which they might encounter. Because of their great gun power and the possession of the speed gage, they would have the complete mastery of any vessels of this type. Possessing seven or eight knots superiority of speed over the British dreadnought fleet, they would be free to accept or avoid engagement, as the circumstances of the hour and place might dictate. Furthermore, there would always be the possibility of their breaking through into the open by way of the North of Scotland, and carrying out a raid along the main lines of steamship travel, which might easily result in the loss of some of the finest ocean liners of the allied powers.

Should we ever find ourselves at war with Germany (which God forbid), the lack of battle-cruisers would prove to be a terrible handicap. For scouting work ahead of our main fleet we would have but three 23½-knot cruisers, and we might use a few of our 22-knot armored cruisers; but of what avail would they be to break through German scouting lines which contain half a dozen 28 to 30-knot battle-cruisers? To send our slow and lightly armored craft against these formidable ships would be not only to fail utterly to ascertain the strength and composition of the enemy, but it would be to offer them for certain destruction. Again, when the main fleet was lined up for battle it would be possible for these fast ships to forge ahead and steam across our line, raking its leading ships with a powerful concentration of heavy gunfire.

The Spanish-American war has not passed so far into history but that many of us will remember the political pressure which was brought upon Congress to send armored ships for the protection of the various important seacoast cities. In the event of such a conflict to-day, we could not spare a single battleship for this purpose; and anything we possess outside of our battleships is worse than useless as a protection against the long range of 11- and 12-inch guns of the German battle-cruisers.

Our submarines? No, we could not rely upon them as a protection; for it has been proved over and over again in this war that ships of 28 to 30 knots have very little to fear from the submarine, so long as they make use of their great speed. Such is the ranging power of their guns that these vessels could steam to and fro, well outside of the range of our coast fortifications, and, assisted by observation of their accompanying destroyers or of seaplanes carried by the fleet, they could silence our seacoast guns with the same deliberation with which the "Queen Elizabeth" has reduced some of the fortifications of the Dardanelles.

One of the most important demonstrations of the present war has been the great value of the combination of heavy guns and high speed. If the next Congress will but listen to its technical advisers, it will authorize the construction, in addition to whatever battleships are required, of at least two ships of the battle-cruiser type.

## The Small Farm Tractor

BOTH mechanical and economic obstacles have confronted the designer and builder of the ideal small agricultural tractor. The wider range of usefulness demanded made it impossible simply to reproduce the successful large tractors in miniature. Extra speeds, more efficient traction devices, greater flexibility and easier manipulation had to be provided for. The impossibility of reducing the width of the tractor in proportion to its power and the number of plows pulled, created a strong side draft in plowing which utterly doomed many a tractor that did admirable work at hauling, for instance, since plowing is the all-important job for the farm tractor.

More frequent use on the road demanded more care in protecting highway surfaces from damage, while still keeping a high tractive efficiency under all conditions. Reduction in size carried with it a natural decrease in accessibility unless persistently guarded against. Reduction in power was apt to increase the weight per brake horse-power and cut down the drawbar delivery unless lighter parts of better material were used.

Manufacturing cost was inevitably increased in proportion to power—increased until the small tractor could claim little or no advantage over animals in first cost. Increases in cost of labor and materials nearly offset the rise in price of horses and feedstuffs, effectually maintaining the *status quo*. Service cost more in proportion. Selling cost the maker less, and he usually reaped the advantage of a larger percentage of cash than on big outfits. But against any possible price inducements rose the increase to the farmer in proportionate labor cost of operating. Moreover a much higher ratio of animal power had to be kept for odd jobs, e. g., a farmer with twenty-five horses might easily get along with a tractor and four instead, while he with but six horses might still have to keep two.

The odds seemed all against a tractor of less than 25 to 30 brake horse-power, giving 12 to 15 horse-power at the drawbar and handling four to six ordinary plows. But horses and their feed rose faster in price than tractors and fuel. (What may be the effect of the war and its enormous drain upon America's horse supply is of course problematical. Probably it will hasten the adoption of tractors hitherto accepted with some hesitation.) The introduction of self-lift plows, which eliminated the plow tender, cut out about a third of the labor cost—a development greatly favoring the small tractor, and one at which inventors of self-contained motor plows had long been aiming.

As a result of these factors, and in response to an incessant demand, we now have our choice of a considerable variety of tractors weighing less than 8,000 pounds (the weight of five or six horses), each designed to do the work of four to ten horses and priced all the way from $500 to $1,600 free on board factory. Some are unquestionably ready for the market. Others are far from it and need be considered only as they represent principles that may "arrive" later. Out of the whole lot there is the strong promise of one or more solutions of this most difficult mechanical problem. For difficult it is.

An automobile has merely to propel itself and carry a load—usually on fairly level, fairly firm surfaces. Light cars fulfilling average requirements have been standardized in ten years to the point of duplication by the hundred thousands. The light tractor, however, must go over almost any kind or condition of soil, up maximum grades, through ditches and over the rough places, pulling a heavy dead load behind it. Yet it must damage no road and pack no cultivated soil.

A car builder whose name is almost synonymous with standardization has put in the greater or lesser part of five years experimenting with small tractors—and still sticks to automobiles. The designer of one of the largest gas engine power plants in the world tackled the problem and failed. One of the leading educators in America along stationary gas engine lines—a consulting engineer and author of a much-used textbook—essayed the design of a tractor for a large manufacturer, but his work never saw the light of day.

## Lest Jack Be a Dull Boy

AN enlightened industrial establishment which provides its employees with ball grounds and tennis courts, reading rooms and card rooms, is furthering its own interests, not only by making its employees better contented, but also by increasing their efficiency. The downright utility of relaxation and rational amusement demands more general recognition than it has heretofore received in America. From time to time we hear of narrow-minded public officials in Washington who endeavor to discourage the rank and file of Government employees from taking the thirty days' annual vacation allowed them by law, by giving high "efficiency ratings" to those who refrain from doing so; whereas a more logical plan would be to penalize employees who do *not* take vacations.

The English, as a race, are decidedly more inclined to rate amusements at their proper worth in the scheme of the human normal existence than are their cisatlantic cousins. An illustration of this fact is found in a comparison of "Who's Who" with "Who's Who in America." At the end of each biography in the former work the favorite "recreations" of the subject are generally stated, while the publishers of the corresponding American work have not seen fit to include this feature.

A compilation of the "recreations" enumerated in "Who's Who" would make interesting reading, and we commend this undertaking to some magazine writer who has run short of topics. They range over a wide field. Many English notables prefer such strenuous forms of amusement as mountaineering, big game shooting, and exploring. Tennis, golf, cricket, and the like naturally recur at frequent intervals in these enumerations. Madame Ada Crossley, the singer, prefers "riding—the favorite recreation of all true Australians." One Irish gentleman (J. P. Crowly) amuses himself with travel, "and anything else that may turn up." An eminent solicitor (Sir Frank Crisp) is evidently a believer in *utile dulci*, for his pleasures are "horticulture, microscopy, and—company law." Prof. James Geikie, who died the other day, admitted that his chief diversion was "loafing in pleasant places with a congenial friend."

## Frederick Winslow Taylor

THE late Frederick Winslow Taylor, pioneer among efficiency engineers, injected a new element into industry. He showed that the proper conduct of a business enterprise is a scientific problem to be solved by scientific methods. In that sense he raised manufacturing to the dignity of an applied science. In another sense he supplied political economy with a new principle; for his study of the problem of production has been a distinct aid to students who never thought it part of the economist's business to concern himself with factory methods. Before Frederick W. Taylor made efficiency engineering what it has become, the directors of an industrial enterprise thought that cheap raw material, good automatic machinery, and a good cost accounting system represented the alpha and omega of manufacturing. But he proved that organization, in the strict military sense of the word, was lacking in most factories; that ideals were wanting; that arrangement of machines was as important as the machines themselves; that the men and executives had to be considered from the standpoint of useful pieces of machinery as well as from the standpoint of labor cost; that a workingman is to be treated with consideration and regarded as an investment rather than as a source of expenditure. Labor unions in particular have misunderstood the work of Taylor. If they only realized it, he and his whole school have done more to improve the conditions of labor, have done more to make the laborer worthy of his hire and the hire worthy of the laborer than all the unions combined. His name will go down not only as a great engineer, not only as a great industrial scientist, but as a great humanitarian.

## Electricity

**Connecting Nitrogen Lamps in Series.**—A writer in the *Zeitschrift für Beleuchtung* suggests the introduction of the series system of connecting nitrogen filled tungsten lamps. A shunt must be provided for each lamp to prevent extinction of the entire series when one lamp fails, and it is proposed that a carborundum resister in solid or powdered form be used, for this, when cold, allows but little current to pass, but when the lamp is extinguished more current passes through the carborundum, heating it, thereby making it a better conductor.

**Electric Confectionery Shops** are to found in St. Paul and Minneapolis. The owner of these shops is a great believer in electricity and he has equipped his tables with candle lamps and desk telephone sets. A customer seats himself at the table, looks at a handy table directory or menu, finds the number of the particular dainty he desires and gives his order by telephone. A minute later the order is placed on his table by a waiter. The system saves a great deal of time because the waiters do not have to make a trip to the table to find out what the customer wants, nor do they have to wait while the customer is deliberating over his choice.

**A Troubleman's Headlamp.**—The troublemen of the Northern Power Company of Duluth are using a convenient type of acetylene lamp arranged, like a miner's lamp, to be worn on the head. This lamp has proved invaluable on locating line troubles at night. Only the lamp and reflector are carried on the head, the generator being carried either on a belt or in the pocket. This is connected to the burner by a non-collapsible rubber tube. The lamp is provided with a single or double lens to concentrate the light, and the reflector which is of aluminium or silver may be adjusted to throw the light up or down.

**Small Tungsten Lamps with Concentrated Filaments.**—The distinctive feature of the concentrated filament tungsten lamps of high wattages have proved so popular that similar lamps in the 25, 40 and 60 watt sizes have now been developed. This concentrated filament construction gives greater vertical distribution of light than the regular lamps of corresponding wattages. The new lamps will, therefore, be employed where natural distribution of light downward is required. They can be used in existing sockets and fixtures. These lamps will be made in the same sized bulbs as the corresponding regular tungsten lamps, will have the same spherical watts per candle-power efficiency and will have a rated average life of 600 hours.

**Illumination of the New Subway Cars.**—After a series of experiments the New York Municipal Railway Corporation has decided upon a new system of illumination for its subway cars. The head lining and walls down to the window sills will be enameled white, so as to provide excellent reflecting surfaces. Bowl-frosted tungsten lights will be used, arranged in a single row along the center line of the ceiling. The cars are 9 feet wide inside and 65 feet long, and there will be fifteen of these 56-watt tungsten lamps supported in 6-inch opal reflectors. The effect of this illumination is to give a soft and uniformly distributed light. The eyes of the passengers will not be exposed to the glare of the glowing filaments. The power consumption of this illumination will amount to under 1.5 watts per square foot.

**The Efficacy of Lightning Rods** on farm buildings has recently been the subject of an investigation conducted by Prof. J. Warren Smith, of the Weather Bureau, who reported the results at the last annual meeting of the National Association of Mutual Fire Insurance Companies. Prof. Smith addressed a circular letter to mutual insurance companies throughout the country, especially those in the rural districts, soliciting information as to the damage done to insured farm buildings by lightning in comparison with losses due to other causes, the distribution of such damage between rodded and unrodded buildings, etc. The answers give striking evidence of the value of rods. In 1912 and 1913 about 200 mutual companies doing a business of fully $300,000,000 had 1,845 buildings struck by lightning. Of this number only 67 were equipped with lightning rods. So far as could be learned about 31 per cent of the buildings insured by these companies were rodded; hence, if the rods had furnished no protection the number of rodded buildings struck should have been 572, instead of 67. Thus the efficiency of the rods in actually preventing lightning strokes appears to have been about 90 per cent. It may be fairly assumed that a large part of the damage done to the rodded buildings occurred in cases where the rods were improperly installed or in poor condition. Five companies, with over 18,000 buildings insured, of which more than 50 per cent were rodded, reported that they had never had a building burned or even materially damaged by lightning that was equipped with a lightning rod; their records covered periods ranging from 13 to 25 years. Another important fact brought out by Prof. Smith's figures is that when a rodded building is struck by lightning and damaged but not burned down, the average damage is much less than in an unrodded building, viz., $10 in the former case and $2200 in the latter.

## Science

**The Radium Institute,** of London, in its last annual report states that 746 cases were treated during the past year, of which 19 are reported cured, 50 apparently cured, and 328 improved, while in 136 no results had been noted up to the date of writing. Varying results are recorded in cases of cancer, tumors, and other diseases. Certain cases of skin discoloration and warts have been treated with marked success, while the most intractable cases of spring catarrh have been cured.

**Drug Addiction in the United States.**—According to a recent estimate of the U. S. Public Health Service the number of persons in this country who are victims of the drug habit is about 70,000, and the number of doses of narcotic drugs consumed by them annually is about 850,000,000. This estimate is based on figures collected in the State of Tennessee, where under a recently enacted anti-narcotic law, 1,403 permits were issued in six months to persons petitioning for the privilege of using narcotic drugs, and the consumption of such drugs amounted to 8,498,200 average doses.

**The Northeast Passage.**—Commander Vilkitskii, the discoverer of Nicholas II. Land, set out last summer from Vladivostock on his third attempt to make the Northeast Passage from the Pacific to the Atlantic. According to news recently received, he was wintered in Taimyr Bay, to the west of Cape Chelyuskin. Here he has been in wireless communication with Captain Sverdrup, who sailed from European Russia last summer in search of the missing Brussilov and Russanov expeditions, and has also wintered on the coast of the Taimyr peninsula. A note in *Nature* states that Vilkitskii proposed to send part of his crew to Sverdrup's ship, in order to economize his supplies, with a view to the possibility of not getting through the ice next summer.

**Rainfall Records in Metric Units.**—Since May 1st, 1914, the British Meteorological Office has published rainfall values in millimeters in place of inches, in its Daily Weather Report. Beginning January 1st, 1915, the millimeter is also used in the Weekly and Monthly Weather Reports. The director of the Meteorological Office, in commenting on this change, points out that metric measurements are now used almost universally in scientific work, and that the maintenance of a system of non-metric units for practical life causes a dissociation between science and practice which is found to be injurious to both. Moreover, the millimeter is a more convenient unit for recording rainfall than the hundredth of an inch.

**Some Interesting Fishery Statistics** relating to the seas west of Norway were presented in a recent lecture by Dr. John Hjort, the well-known Norwegian fishery expert. The work of tagging fish, setting them free, and recording the time and place of subsequent capture has now been in progress for a number of years and has given most valuable information as to the migration of fish and as to the ratio of the catch of any given year to the total number of fish available. This ratio is about 1 to 10 in the case of the common food fishes. Attention has also been paid to the age and growth of fishes, as indicated by annual rings on their scales, and it has been learned, among other things, that fish make faster growth in some years than in others, regardless of their individual ages.

**Sea Moss.**—This term is popularly applied to any of the *Polyzoa*, which are compound marine animals, several of which share a common horny skeleton, or polyzoary, which is plant-like in form. According to the Bureau of Fisheries, several hundred thousand pounds of these skeletons have been imported annually from Europe, chiefly from France and Germany, for decorative and millinery purposes, and the supply has now been practically cut off by the war. It therefore seems opportune to develop a domestic industry, as sea mosses, probably equal in quality to those heretofore imported, are said to be abundant on our coasts, especially in New England. Those with large bushy fronds are the most valuable.

**The Colorado Geographic Board.**—The Colorado Geographic Society, recently founded in Denver, has organized a small committee known as the Colorado Geographic Board, the duties of which are to supervise and clarify the geographical names of Colorado, to collect and preserve the historical associations of towns, streams, mountains, highways, passes, and other geographical features of the State, and to eliminate duplicate and otherwise undesirable geographical names. The board has announced that it will "attempt in every way to secure a nomenclature that will be appropriate and that will reflect the romance and adventure of historical and pioneer days in Colorado." It is not the intention to make radical and sweeping changes in names, but to settle questions as they arise and to bring about needed reforms gradually. This undertaking appears to be wholly admirable and worthy of imitation in other states, always provided it is conducted by intelligent and scholarly persons, as appears to be the case in Colorado.

## Automobile

**Looking Underneath the Motor Car.**—Many a prospective purchaser of a motor car would like to take a peep below the chassis—when he views the car in all its glory in the salesroom. A Chicago dealer has solved the problem by hanging one of the show cars 7 feet above the ground, supported by strong steel cables. The height enables both salesman and "prospect" to walk beneath the car and examine it from below.

**An Automobile Lock.**—Thomas J. Kehoe of Toledo, Ohio, has secured patent No. 1,126,781 for an automobile lock which has a swinging arm pivoted at one end to the ordinary slotted guide for the controlling lever of the engine. This arm has at its swinging end a notch which can be swung to receive the controlling lever when the latter is in neutral position and a lock secures the swinging arm in this position.

**Elastic Safety Bumper for Motor Cars.**—A novel type of automobile bumper has just been brought out by a New York company. It consists of a hollow rubber tube, supported on a steel fender, beyond which it projects about two inches. Should any person or object be in danger of collision with a motor car so equipped, a large part of the shock is absorbed by the rubber tube, while the rest loses itself in the springs which support the steel fender itself.

**The Auto Tire of the Future.**—Many improvements have so perfected the auto tire as even to render racing comparatively safe. It is believed, however, that some radical departures will mark the greatest development in this line. Just where this is to be is difficult to say. Inventors have been improving the inner tubes, the tread surfaces of the shoes, the fabrics and the means for holding the shoes to the rims. Possibly the tire to revolutionize the industry will combine the air cushion and spring features in such a way as to overcome the defects and shortcomings of both forms.

**Triplex Glass Now Greatly Used.**—Triplex glass, which created a good deal of comment when it was first announced a year ago, is now appearing on the market in many forms, especially in Great Britain, where it has caught the fancy of motorists. The glass is made into limousine windows, windshields, goggles, etc. It consists, as readers of the Scientific American will remember, of two sheets of thin glass with a thin sheet of xylonite between them, the whole three sheets being combined by glucose and hydraulic pressure into a homogeneous mass. It cannot be shattered into splinters by any agency. It will crack and break under hammer blows, but no splinters will fly, endangering people.

**Vulcanizes Tires by Chemical Means.**—Although strictly speaking every vulcanization of an automobile tire is a "chemical reaction," the system invented by W. A. Miles deserves this appellation more than any other, because of the application of heat by a new method. Instead of using steam or electricity, Miles takes a small block of a deflagrating substance, as for instance a mixture of charcoal and saltpeter, or chlorate of potassium and wood dust. Putting the mixture, in form of a pill or block, on a metal plate in contact with the tire, it is ignited and the heat developed used to vulcanize the tire repair patch. The size of the "pill" can be regulated to give just as much heat as is needed for the vulcanization.

**Synthetic Rubber from Crude Oil.**—So many disappointments have been recorded following announcements of new methods of making rubber synthetically, that rubber importers and users are now exceedingly wary in accepting statements to that effect. But news has just come from Baku, Russia, which seems valuable enough to deserve a thorough test in the California oil fields. It seems that there are certain fractions in the Baku crude oil (which are also prevalent in the California oil) boiling between 98 and 106 degrees, which yield nearly 20 per cent of their weight in adipic acid. This adipic acid can be converted into butadiene through the action of its own amide, in a commercially practicable process. Butadiene, again, can be converted into caoutchouc by means of another simple and inexpensive process. Experiments are already under way to discover the practical value of this discovery.

**An Anglo-French Car.**—Among the things that were not talked about much abroad formerly but which the friendlier feeling created by the military alliance is bringing to public notice is the close relations that have been sustained in the automobile manufacture between England and France. In this connection note is being made of a popular car that was designed by an Englishman, and is built in France by an Anglo-French company. A new model of this car, just brought out, has four cylinders 85 millimeter bore by 130 millimeter stroke and rated at 16 horse-power, and is said to have given excellent performances over hilly and difficult roads. The cooling water is circulated by a pump, and there is a pump operated automatic lubricating system that is attracting attention on account of the absence of all small by-pass holes that so frequently choke and make trouble.

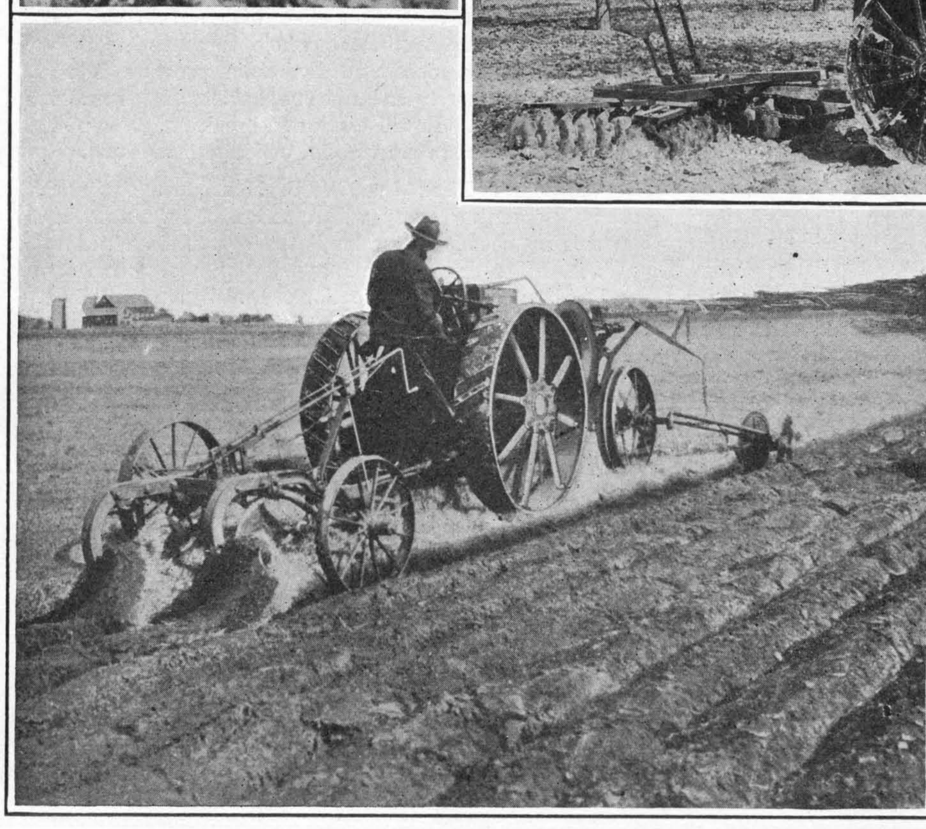
# Progress in Small Farm Tractors

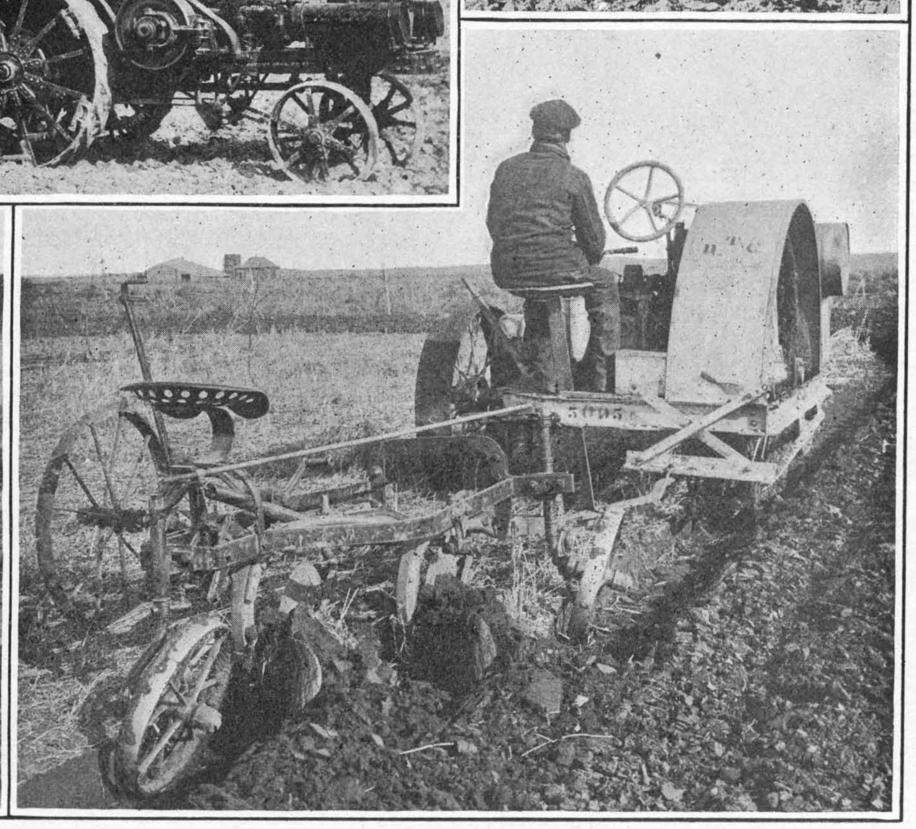
By L. W. Ellis, Vice-President, American Society of Agricultural Engineers

## A Real Agricultural Need and What Engine Builders Are Doing to Meet it

A rotary soil cultivator or milling machine. A drum-like arrangement of flexible steel springs each carrying a flexible claw at the end is the interesting feature.

The bulk of tractors are built to draw plows or other implements in the rear. One tractor is arranged to receive a gang of plows attached directly to the rear, lifting it by motor power.





The majority of the manufacturers cling to the conventional round wheel type for their large tractors, but cast tradition to the winds in attacking the small tractor problem. The small tractors with two drive wheels in the rear and smooth tires fitted with some form of cleat are, therefore, in the minority. Width must be kept down in order to avoid side draft in plowing, also to permit the use of the tractor in vineyard cultivation. Height must, therefore, be kept down for the sake of stability; also to permit of orchard cultivation. The four-wheel drive has been tried with indifferent success. The single wheel is later, cheaper, and more promising. One large drive wheel, usually at the right side of the tractor, brings the power directly ahead of the plows, idler wheels opposite completing a three-point support.

### PROGRESS IN SMALL FARM TRACTORS

*The "average farmer," one operating not over 160 acres of land and keeping probably not over six work horses or mules besides young, driving and breeding stock, needs a tractor, one simple enough for him, his son, or the hired man to operate; light enough in weight to spare bridges and culverts; low enough in pressure per unit of ground surface to avoid packing his well-tilled land; powerful enough to replace at least five horses in plowing, thereby handling at least two plows; and price not to exceed the value of the horses which may be sold when the tractor comes to the farm to stay.*

*How these problems are being attacked Mr. Ellis sets forth in the following article.*—EDITOR.

THE scrap heaps of large tractor factories of solid reputation are strewn with small tractor failures. The Middle West has seen literally hundreds of minor concerns start, experiment away their capitals of $5,000 to $50,000 each, and quit, perhaps lasting long enough to sell a few engines at an attractive price and include the customers in the final disappointment.

The writer has positive knowledge of five absolutely different small tractors built and discarded by one big firm before it first placed the sixth on the market—that after a tractor building experience of a quarter century. Another firm, equally experienced, built seven models and spent three years in experimental work before issuing its first catalogue on a small tractor. These facts partially explain why the small tractor has been slow in coming—why the older, more substantial builders are now demanding prices that seem unreasonable in view of quotations made by smaller manufacturers.

Building a small tractor is no child's play, but ten times harder than building a big one, even having the experience with the latter to start with. There are few rules and no precedents. Practical experimentation has done the most to develop what we have to-day, and the Middle Western professor of farm engineering was talking very sanely who said last summer that $1,000 was a minimum price for a reliable small tractor produced in present quantities. Without exception the tractors so far announced at sensationally low figures have either been materially increased in price or disappeared entirely from the market.

As to the final type of tractor for the small farm, the industry is in a too unsettled state to make predictions safe. From steam threshing engines to monster plowing steamers; from steam plowing engines and

mere self-propelling stationary gasoline engines to a fairly standard type of 60 to 75 horse-power gas tractor; then rapidly down the scale to the present wide diversity of small tractors, the range has been covered in fifteen years. The great gas tractor boom of 1911 and 1912 brought its reaction, as much from outside causes as from over-selling the market or disappointment in the product. Since then, the pioneer manufacturers have proceeded along more stable lines. Their offerings of small tractors have been few, but their types are good. Each week, meanwhile, brings out new names and new models, each valuable as a contribution to the sum of tractor experience, if not permanent in itself. The types discussed in the following paragraphs have been selected mainly to illustrate prevailing principles, and are not necessarily recommended in their present state.

The small tractors of note may be classified, for convenience, with respect to (1) power plant; (2) traction device; (3) kind and arrangement of tillage implements (this being the most influential factor affecting the design); and (4) special types. Outside of a few conventional designs, any combination of principle may be expected, and the coming of the ideal type will certainly not be delayed by any lack in this direction.

**Motors.**

Due largely to the great improvement of the automobile motor and the educational influence of the farmer's motor car, there is a distinct tendency toward the four-cylinder motor in the higher types of small tractor. While formerly considered more complicated and less economical of fuel, its advantages in lightness, flexibility and evenness of torque over the one- and two-cylinder motors are rapidly popularizing the four-cylinder type. One company specializes on small tractor motors and supplies a large number, especially for experimental machines and the newer commercial types. The well-established makers, as a rule, prefer to build their own motors, on account of both price and adaptability. It goes without saying that even small tractor motors are nearly all of a heavy duty type and usually of not over 750 to 900 revolutions per minute.

On the other hand, some of the largest makers retain the two-cylinder motor, twin and opposed types being in about equal favor. This results in a somewhat lower price and a considerable heavier type. The single-cylinder motor is seldom used for tractors as small as those we are considering, though attempts have been made to avoid excessive weight by running a small cylindered motor up to 500 revolutions per minute.

**Ingenious Traction Devices.**

The majority of manufacturers cling to the conventional round-wheel type for their large tractors, but cast tradition to the winds in attacking the small tractor problem. Small tractors with two drive wheels in the rear, and smooth tires fitted with some form of cleat or grouter, are therefore in the minority. Width must be kept down in order to avoid side draft in plowing, also to permit the use of the tractor in vineyard cultivation. Height must, therefore, be kept down for the sake of stability, also to permit of orchard cultivation. The permissible wheel dimensions are not always adequate for good traction, and variations from the conventional two-wheel drive are the rule.

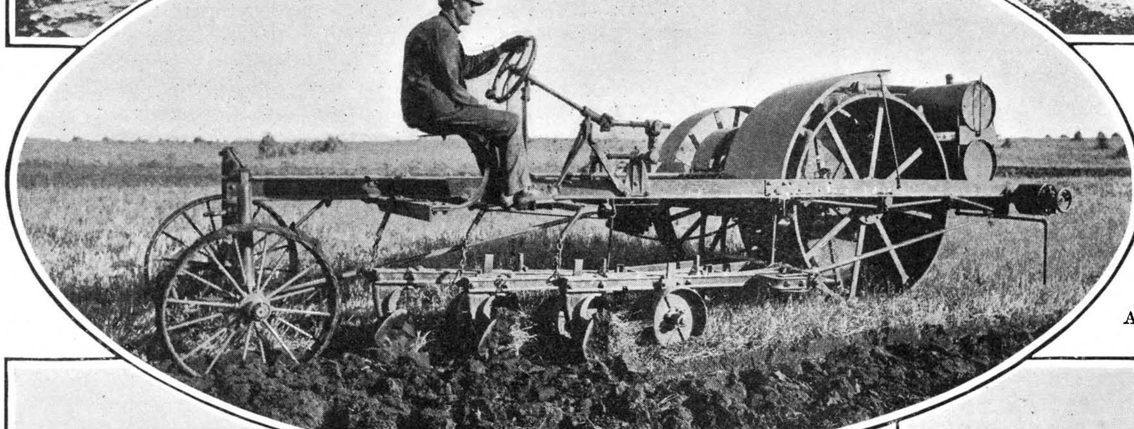
The four-wheel drive has been tried with indifferent success. The single wheel is later, cheaper and more promising. One large drive wheel, usually at the right side of the tractor, brings the power directly ahead of the plows, idler wheels opposite completing a three-point support. This type is quite compact and easy to guide. One difficulty lies in the fact that there is no second driver to assist in case the one strikes a soft spot, as in a two-wheel drive having a differential that may be locked. Another lies in the individual design of one tractor, the drive wheel running in the furrow and undoubtedly creating a hardpan similar to the "share hardpan" formed by one horse's feet and the plowshare. One single-wheel type has the drive on the left side for greater convenience in harvesting with binders. Left-hand plows must, of course, be used with it.

The single driver idea is used in combination with an endless track, also in several self-contained motor plows. It is capable of being very cheaply constructed, and has been exploited on a large scale within the last year, the majority of makers aiming at a cheapness which cannot but react against the type, however good it may prove in the end.

A number of builders have accepted the limitation as to size of driver and sought to make it more efficient by improving the gripping arrangement. Tires of open construction are used, also several forms of fixed paddles so arranged as to imitate the course of the horse's hoof as it enters and leaves the ground. The extra expense of construction is probably justified by the advantage in tractive efficiency. Spikes and spades arranged about an eccentric, appearing and disappearing automatically in some cases, and in others merely capable of being thrust out and withdrawn to give points, have been offered repeatedly, but have been discarded in practically every case because too complicated and too easily jammed.

**Endless Track Types.**

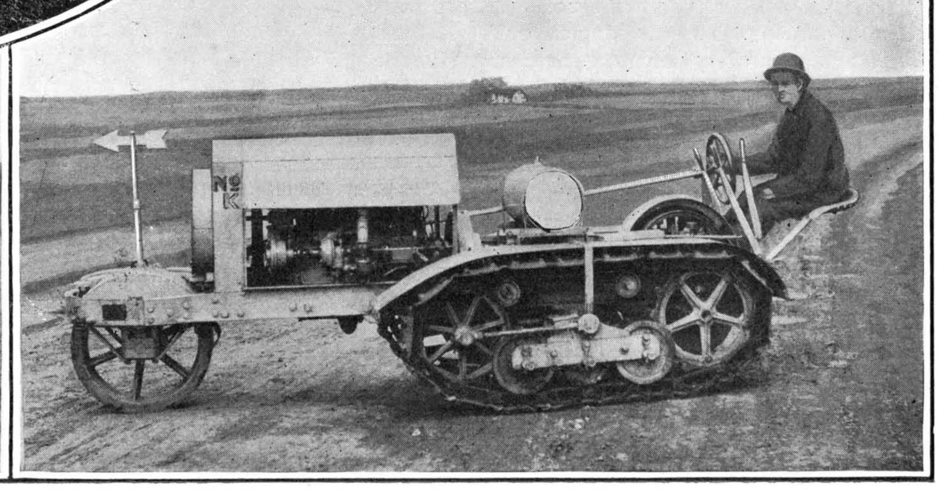
Another, and probably the most important, variation from the wheel type is that which substitutes a wheel with movable pedals jointed to the rim (not common in the United States), or else an endless apron, or track, composed of segments, either device affording much greater contact with the ground than the ordinary wheel. This class, frequently referred to as the "caterpillar" type (though the word "caterpillar" is a registered trademark applying to but one manufacturer's product), has come to the front very rapidly. While especially well adapted to large units, because the seg-



The small tractor which the average farmer needs must eventually do many things the big tractors did not do—that is cultivate vineyards or orchards, even corn and potatoes, perhaps; make more frequent trips to town with ordinary teamloads; and do odd jobs in odd corners about the farm. It must do many things horses seldom do in the way of running stationary machinery. And it must do or attempt practically everything expected of farm horse and giant tractor combined. Above all it must not be a fad or a luxury. It must pay its way, showing a low upkeep cost, reasonable operating cost, and sufficient versatility to keep overhead charges distributed over a maximum of working days per annum.

A one-armed man operating a small tractor is shown in illustration on left.

Harvesting is only one of the many tasks which will have to be performed by the small tractor. Indeed, so diverse are the applications of the tractor that one manufacturer calls his machine a steel mule.



The caterpillar type has come to the front very rapidly. Tractors of this type weighing less than six thousand pounds are easily doing the work of eight to ten horses.

PROGRESS IN SMALL FARM TRACTORS

mental track will transmit the power of an extremely large motor without requiring a corresponding increase in weight, it has peculiar advantages in small units as well.

The latest form of track consists essentially of (1) open-sided steel castings which form both shoes and connecting links; (2) steel sleeves and pins forming the joint between units; and (3) chilled truck wheels which roll upon the inner, rail-like surface of the links and carry the tractor's weight. The efficiency of this device in crossing soft ground and in avoiding the packing of the soil has long been recognized, but the multiplication of wearing parts has required careful choice of materials and good workmanship in avoiding an excessive unkeep cost. Authentic instances are now on record, however, to indicate that a well-constructed track should stand 5,000 to 8,000 miles of wear before renewing, and the matter of upkeep is, therefore, not serious. The higher first cost of this type is, of course, to be balanced against the ability to work under very unfavorable conditions.

The track is neither wide, nor high, but *long*, hence enormous traction is gained without violating either limitation to ordinary wheel dimensions. There is no slippage under ordinary circumstances, a factor which loses from 6 to 10 per cent of a round-wheel tractor's geared speed under normal conditions. The greater tractive efficiency naturally assists in keeping down the fuel consumption, but its particular advantage in the small tractor lies in its cutting out the side draft without unduly increasing the weight of the machine, and in enabling tractors of this type to climb surprising grades. Tractors of this type, weighing less than 6,000 pounds, are easily doing the work of 8 to 10 horses.

At least a dozen tractors now embody something of this principle, with certain variations as a concession to patent formalities. One maker substitutes two-inch balls for the truck wheels carrying the tractor's weight. One newer tractor uses but one endless apron instead of two. Practically all omit the differential gear and turn much shorter by means of separate friction clutches governing either side of the track independently. Infringement proceedings may affect the status of some models in this group.

**Arrangement of Plows.**

The bulk of tractors, large or small, are built to draw plows or other implements in the rear by means of rods or chains. One tractor is arranged, however, to receive a gang of plows attached directly to the rear, lifting it by the power of the motor. Others, both one- and two-wheel drive, become self-contained motor plows through gangs hung under the frame between front and rear wheels. These outfits have the advantage of being able to back up and turn square corners when plowing, thus finishing up corners somewhat more neatly and allowing the operator at will to plow around a field as with an ordinary horse plow. The main disadvantages lie in the fact that such an outfit tends toward either excessive height or excessive length, to accommodate the plows; in that the distribution of weight, if proper for plowing, is less efficient at other work; and that in case of miring there is no opportunity to disconnect the plows quickly and rescue tractor and plows separately. The self-lift plow threatens to lessen the opportunity for this type.

A tractor somewhat upon the order of the most popular type in Germany, but much smaller, consists of a balanced frame supported by two narrow drive wheels of large diameter. The motor forward balances the plows in the rear. Ease in steering, good clearance, and simplicity, are the main advantages.

Several years ago the writer was moved to remark upon the possibility of a power plant which might be attached in turn to various ordinary farm machines to make them self propelling. Such is the purpose of one manufacturer, who carries the motor upon a light, two-wheeled chassis, the operator controlling it from the seat of the implement drawn behind.

A type given considerable prominence about two years ago, but apparently so far lacking in some vital mechanical refinement, is the motor hoe, or cultivator, similar to the type just described, but carrying light tools attached, the whole guided by an operator who must walk and hold the handles.

**Soil Milling Machines.**

A final type, not yet commercially important, is a class of rotary soil cultivators, or milling machines. One of Swiss invention is now being manufactured in the United States. The interesting feature is the working tool, which consists of a drum-like arrangement of flexible steel springs, each carrying a flexible claw at the end. At a speed of 150 revolutions per minute the work of this tool is surprising, whether in hard, soft, foul or stony ground. Scratching the earth, rather than cutting, it pulverizes to a maximum depth of 12 inches and prepares a superior seed bed at one operation. From the agronomic standpoint the work is most excellent. Mechanically, considering only the tool, and assuming that the tractor and method of driving the tool are good, being conventional, there is only the question of replacements to springs and teeth to consider, as the work is satisfactory. Economically there comes the question of how many will (not should) introduce a tillage method which apparently consumes so much power (three acres a day—10 to 12 inches deep—is the capacity of a 1,400-pound machine similar to the one illustrated). But one trip over the ground is made, however, as against several with ordinary implements preparatory to planting, and it has been found that the working tool—not the drivers—actually propels the outfit while working. Crop increases, after all, should pay well for the extra cost of work. Other rotary machines, larger and less successful, have been made, but none of commercial importance.

The number and variety of small tractors is so great that this article has been able merely to touch briefly upon tendencies, general principles, and something of the present status of the industry. In the face of such evident disagreement as to the eventual type, the safest course in buying is to investigate all claims thoroughly, and insist that the product shall be past the experimental stage, and the firm behind it permanent and substantial.

## The Windage of Shot

THE present hostilities in Europe have revived the old discussion as to wind-contusions caused by shot and shell and some strange stories have been told of men dying or seriously injured without external signs of wounds. The question that has been raised is, Can the displacement of the air caused by the passage of a projectile produce serious and even fatal organic lesions when a man is not struck by the shot?

It was customary in former days to attribute to this trauma without contact the most singular derangements and even sudden death. When, however, the French military surgeons of the republic and the empire carefully investigated the problem, the theory which attributed such results to the windage of cannon-balls and shells broke down before the analysis of the actual facts.

A physician, discussing the question in the Paris *Temps*, speaks of Larrey, the noted army surgeon of the era of the first Napoleon, who "showed, in the memoir he presented to the Surgical Society, that all that had been related of the phenomenon disappeared into the domain of legend or arose, rather from a wrong interpretation. After the appearance of this memoir the question was considered as finally settled and the treatises on miltary surgery during the nineteenth century disdainfully ignored it."

Nevertheless, the question so vehemently argued and rejected in days gone by has been brought up anew by the occurrences of the present war. Our author in discussing the problem under its present form says further:

"On one side and another facts are quoted which seem to compel us to acknowledge that disorders caused by the passage or the sudden sharp combustion of a projectile near a man are perfectly admissible. Messrs. Lannois and Chavanne have named to the French Academy of Medicine soldiers who have been made deaf, probably permanently, by the bursting of a shell near them. There are cases where an ordinary ball which only touched the external parts of the ear has caused a perforation of the membrane of the ear-drum that, however, remained outside of its direct action. Monsieur Sencert of Nancy reported to the Surgical Society, at one of its last sessions, the story of a man who died from having beer in the immediate vicinity of the bursting of a shell of large caliber, although he was at least a meter from the point of explosion. The man was not even touched by a splinter of the metal, yet it was found that both lungs had burst. A fairly large number of similar facts have been related since the beginning of hostilities. Exact statements of the cases being lacking, more or less complicated reasons have been brought forward to explain them. There has been talk of fulminating poisonous gases disengaged by the explosion, of violent and sudden nervous concussions. Monsieur Sencert's account, however, shows that no such explanations are necessary, and that the sufficient reason in these cases, which are moreover unusual, is a mechanical effect that bears a strong resemblance to the wind-contusion of former times."

Perhaps, though, this resemblance is somewhat deceptive. Outside of the case of a ball which perforated an ear-drum without touching it, the question seems more one of analogy than of actual identity. The physician of the *Temps* in presenting this view of the subject says:

"The difference between the projectiles of to-day and those of former times is so great, their speed has increased so remarkably, and above all, the combustible element has such great power, that the present testimonies hardly serve to explain the mysteries of past eras. We are obliged to-day to admit that the bursting of the formidable projectiles used by the armies must produce extraordinary differences of pressure and that necessarily, at least within a certain radius, these differences can induce lesions serious for the organisms which suffer them. This has now been proved, but in this alone is summed up for the surgery of the present war the problem of windage, the elements of which have varied to a singular degree since the days it was proposed for the first time and ever since the epoch when Larrey totally denied its existence."

## Why a Whip "Cracks"

WHY does a whip "crack"? Probably the coachman most adept at the art would not be able to tell you. And no wonder. For the reason is one that has puzzled some of the greatest authorities on dynamics. An explanation was tentatively offered recently by Prof. C. V. Boys in the course of the series of lectures for juveniles at the Royal Institution. Briefly, it has to do with the fact that, owing to the action of centrifugal and other forces, the speed at which the whip travels through the air is greater and greater throughout its length, and so great at the end that it comes up to the velocity of sound.

"Mechanics in the Home" is the alluring title of the series of lectures, and by means of very interesting experiments the professor showed what are the principles underlying various every-day and, apparently, simple devices. Friction, for instance, is one of the greatest. To the wonderment of his boy and girl audience, Prof. Boys took some "safety" matches out of a "strike only here" box, and set them alight with the greatest ease on a glass bottle and a piece of mahogany. They thought it was a miracle, until the lecturer explained that the friction was sufficient to make the match get hotter and hotter until it flamed. But, be it added, the surface on which a "safety" match is struck must be perfectly smooth, otherwise the roughness will rub off the substance on the tip. It is friction, too, which prevents a wedge jumping out after the blow that has driven it into, say, a log of wood.

Apropos of "impact considered as a self-adjusting leverage in time," the boys learned why, when a cricket ball is hit too near the end of the bat, the hand is stung. It is because the impact, coming at that particular point, drives the bat up. Just as it did to both ends of a stick which, when the lecturer broke it by a sharp blow exactly in the middle, flew away in halves, leaving undisturbed two water-filled glasses on which it was resting.

## Motion Pictures in Medical Schools

THE motion picture has invaded the realm of medical school instruction. The specialists in diagnosis have discovered that there is no other way in which they can so vividly present to medical students the difference in diagnosis between similar physical appearances as by means of the moving picture. Dr. J. Ivan Dufur, professor of nervous diseases at the Philadelphia College of Osteopathy, is the originator of this method of teaching which, it is believed, will revolutionize medical instruction. Dr. Dufur has, as the result of a year's labor, succeeded in preparing a set of reels, including demonstrations of actual cases of every one of the principal nervous diseases. Harrowing experiences were necessary in the preparation of some of these reels. Dr. Dufur and the photographer were locked for four hours at one time in a room with a dozen insane epileptics waiting for a characteristic fit.

The osteopathic practitioners are greatly interested in this method of diagnosis and these reels are being exhibited at State conventions of that school of practice and are being used in their colleges.

## The Current Supplement

THE leading article in the current SUPPLEMENT of the SCIENTIFIC AMERICAN, No. 2048, for April 3rd, 1915, A Record of Achievement, is a discussion of what the chemist has contributed to the industrial development of this country of the utmost importance to every manufacturer and citizen, and its author is an acknowledged authority on the subject. Unloading Bananas tells of a rapid method of handling this delicate fruit from the ship to the railroad. Sherardizing describes a valuable process for rust-proofing metals. The Zeppelin Question gives many timely details relating to the size and capacity of these much-talked-of aircraft. The Influence of Radio-active Earth on Plant Growth describes some most interesting practical experiments on the application of radio-active material to agriculture. The Effects of Climate on the Location of Manufacturing Plants discusses an economic question that has not heretofore been properly appreciated by those who control industrial enterprises. The New Knowledge of Coal Tar is a most valuable explanation of scientific methods for the utilization of all the constituents of coal, many of which are now wasted. The article on Photographing Projectiles is concluded, and there are interesting articles on Gasoline Locomotives and Some Questions of Evolution.

# Correspondence

*[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]*

## National Defense Approved

To the Editor of the SCIENTIFIC AMERICAN:

You are doing a most patriotic work in your advocacy of adequate national defense. The writer, while welcoming any expression of this idea, was a bit surprised to see this most vital matter referred to in no less an organ than the church calendar of one of the most powerful of our city churches. Leaven in such places is bound to work. H. A. FREEMAN.

Newark, N. J.

## Origin of Khaki Uniform

To the Editor of the SCIENTIFIC AMERICAN:

In the issue of February 6th, on page 124, the statement is made in the article "The Art of Deception in War," that "in the Boer war khaki first came into general use." This is not in accordance with facts. Khaki has been in use in the British army on active service for more than forty years. It was in use in the Jowaki Expedition in 1877. Again all troops (British and native) engaged in the Afghanistan war, 1878-79-80, wore khaki. Even the shoes were tan colored leather, sword belts and saber scabbards were tan colored leather, helmets were covered with khaki covers and puggarees. Buttons and buckles were not polished. The pomp of the parade ground was entirely absent. In the second campaign of that war, 1879-80, the carrying of colors into action was abandoned, they being left with the depots at the base.

By the way, khaki is a Hindostani word meaning brown. W. A. MAYES.

Mt. Penn, Pa.

## Left Hand vs. Right Hand Drive

To the Editor of the SCIENTIFIC AMERICAN:

I notice in your issue of January 23rd an article by C. C. Blackmore, entitled "Left-hand vs. Right-hand Drive," in which he states that there is not a tendency for drivers of left-hand drive cars to "hog the road." With all due respect to Mr. Blackmore, I fail to see how he reaches the conclusions he does, unless conditions in Ohio are much different from what they are in and about New York. I have driven both right and left-hand drive cars, and speaking from personal experience, I must say that everything is in favor of the old right-hand drive. The only possible exception to the above is the town car, built exclusively for city use. On such a car left-hand drive is often convenient, but to my mind the difficulties of making a decent landing at the curb, or backing into place at the curb, more than outweigh any possible advantage.

For touring and general pleasure driving the right-hand drive is the safest and most convenient, and, moreover, it is a fact that drivers of left-hand drive cars, do have a tendency to "hog the road" in passing. The reason, I think, is obvious to anyone who has handled both kinds of car, and is briefly as follows: The driver of a left-hand drive car can see perfectly just how much room he has in passing a vehicle moving in the opposite direction, but what he *cannot* see is just how much room he has between his right wheels and the edge of the road, which more than likely is soft, or even unsafe. The result, and it is a perfectly natural one, is that he turns out *only* just enough to clear the approaching vehicle, and more often than not leaves from two to three feet of good road on the right, while the clearance on the left is a matter of inches.

The driver of a right-hand drive car can see exactly how much room he has on the right, between his car and the edge of the road, and so he knows just how far he can safely turn out in passing. He cannot see so well how much room he has on the left, but he knows from the width of the road that if he hangs well to his own side there is plenty of room. The result is that he turns out to the right, not as in the case of the left-hand drive, only just enough to clear the approaching vehicle, but as far as he can, and passes the vehicle on his left by a safe margin.

There is probably some psychology involved in this reason, which may be stated as follows: When a driver has to pass two things simultaneously, whose exact position in reference to himself he can see with different degrees of exactitude, he will naturally tend to pass the one he can see the best, by the smallest margin, in order to allow as much room as possible, and thus be on the safe side, in passing the other obstacle whose position he cannot see so clearly. The two things to be avoided are of course the approaching vehicle, and the edge of the road, which may contain a fence, tree, telegraph pole, or may be soft or otherwise dangerous. For this reason a driver of a right-hand drive car will avoid the other vehicle, and pass well to the right, while the driver of the left-hand drive car will avoid the edge of the road, and "hog the road."

There are many other things that could be said in favor of the right-hand drive, but the article I refer to in your issue of the 23rd instant only treats of hogging the road as applied to right and left-hand driven cars, and so I will limit this communication to the things mentioned therein. I feel certain that if an investigation were started, based on actual observation and inquiry, the great majority of cases would turn out as I have stated. O. B. POTTER.

Ossining, N. Y.

## Nature Our Most Available and Reliable Ally

To the Editor of the SCIENTIFIC AMERICAN:

The only life-sustaining element that man cannot use to excess is air. To provide for its purity and make every breath a fresh one, the warmth of the outgoing breath instantly escapes upward, and is Nature's bar to suffocation. Medical inhalation would be impossible apart from its being ingrafted upon the breathing function.

When anesthetics were ingrafted upon the breathing function in 1846 there was no recognition of Nature's protection against suffocation in the outgoing breath. because of its warmth. In fact, so little thought has been given to this wise provision of Nature, that a vast majority of our most intelligent citizens are unable to tell why every breath we take must be a fresh one. Is it strange, then, that when the inhalation of ether and chloroform was ingrafted upon the breathing function, this natural law should have been entirely ignored? That it was and has continued all these years, constitutes the most thoughtless misconception of natural law of the century.

In June, 1898, a specialist became impressed with the idea that all drugs used by inhalation should be normally diluted with air, so that the medical effects should be added to the ordinary life-sustaining breathing function, and he made the drawings for a glass device that, by the shape of the bulb and direction of the internal air tubes, should cause a revolving current of air over the medicament within, thus diluting the medication with the natural amount of air.

This device was taken to the annual meeting of the Massachusetts Medical Society and exhibited with anesthetics in them for the first time. They created much interest and surprise that, though open at both ends, there was no escape or odor of the ether or chloroform, from which we ascertained that in a temperature of 70 to 71 deg. Fahr. the atmospheric pressure held in check the expansive, evaporative force of these anesthetics. Using this as a basis, it was found that each additional degree of heat increased their expansive, evaporative pressure one pound, which, with the automatic revolving current of air, have proved to us that the nausea, vomiting, pneumonia, and deaths following anesthesia were due to our neglect to dispose of the outgoing breath as Nature has done in the function of breathing, and not, as we supposed, by the anesthetics themselves.

By its producing the conditions of natural sleep, it shows us that the natural action of anesthesia embraces only the functions under mental control, and does not interfere with the automatic action of the striated muscular fibers of the heart and organs that sustain life when we are unconscious. It has also shown that ether bears the same effective relation to chloroform that light wines do to whisky and brandy, and that the visible effect of anesthesia upon the human system is much the same as intoxication, only the recovery from anesthesia was as complete in as many minutes as it took hours from alcoholics.

The presentation of these facts has changed the medical conviction so long announced by our Government, that "chloroform was a dangerous drug, and never should be used save by a physician or in his presence," to allowing its sale at any drug store in America, to anybody without reference to a physician or his order.

No remedy known to man so uniformly and quickly relieves suffering, and it is the *only one* that suspends its own use as soon as relief comes. Its wonderful power of producing muscular relaxation is likely to revolutionize the treatment of spasmodic affections.

Boston, Mass. WILLIAM B. HIDDEN, M.D.

## Troops to Guard the Coast

To the Editor of the SCIENTIFIC AMERICAN:

In the February 6th issue of the SCIENTIFIC AMERICAN, on page 120, attention is called to the need of "coast guard" troops which will be necessary to guard the approaches to our cities, the coast defense works at and about our harbors, this force being estimated at nineteen divisions or about 380,000 troops, of which 275,000 will be required on the Atlantic coast.

The writer would like to call attention to the fact that there is no distinction between the "coast guard" as used in the article referred to and the "mobile army." Coast guard in this sense is a misnomer, as the term is already in use by the Government in connection with the Life-Saving Service. Its use as applied to a part of the national defense should be discontinued, as it gives rise to misunderstandings and false impressions in the public mind. The only "coast guard" in the military sense is the mobile army; and the only coast guard we should have or need is a well-organized mobile army, fully equipped and trained to move at a moment's notice to any threatened point or points. The national defense comprises three elements, viz.: the navy, the mobile army, the coast or harbor artillery. If the navy be defeated, eluded or bottled up, an enemy is free to land anywhere on our shores that it pleases him, except in the fortified harbors. The only defense against such a move is a mobile army. The other coordinate arm of defense is the coast, or more properly, harbor artillery, whose rôle is strictly limited to the water approaches of our fortified harbors.

If one will consult the "Report on the Organization of the Land Forces" published by the War Department in 1912, he will find therein the most perfect plan for organization of our land forces ever promulgated. It is the result of years of conscientious labor and study by the General Staff of our needs for adequate defense, and it is a most satisfactory compromise between the demands of the military ideal on the one hand and our national traditions of a small standing army on the other.

As is well known from the reports in the press, there has been drawn up, by a committee of the General Staff, a measure in form for legislation which puts into practical form the provisions of the "Report on Organization of 1912." It is this measure which Senator Chamberlain gave notice to Congress and the people that he would call for at the next session, and is the first comprehensive measure ever offered to Congress in the line of legislation for the land forces. All branches and arms are considered and provided for—mobile army and coast artillery—and the first step toward putting our defenses in a state of reasonable preparedness should be to enact this General Staff measure into a law.

The greatest defect in our land defense is the lack of organization of the mobile army. The writer of the series of articles now running in the SCIENTIFIC AMERICAN clearly demonstrates that point, and the urgent need of a reasonable increase in the numbers of both branches of the land defense. The mobile army, however, is the "coast guard" as he uses the term. We have no other use for a mobile army than just that, so far as it is to be used against an enemy; certainly not for one of the size he mentions. If we ever have occasion to use it otherwise we must of necessity be in such a position, so far as our enemy is concerned, that we shall need no coast protection.

In view of the importance of this question of our preparedness, or lack of it, to meet any reasonable danger which may confront us as a nation, it is suggested that a study of the advice of the military experts whose business it is to provide for our defense and to advise Congress of the necessary requirements in men and money will enable the layman to decide for himself what is our most pressing need at this time. For this purpose, it is imperative that the measure prepared by the General Staff for this very contingency be placed before the people in Congress at the earliest possible moment at the coming session. It is the duty of every citizen to make it his business to see that his Representative in Congress shall support the measure above referred to and see to it that it is enacted into law without delay. TILDEN BLODGETT.

New York.

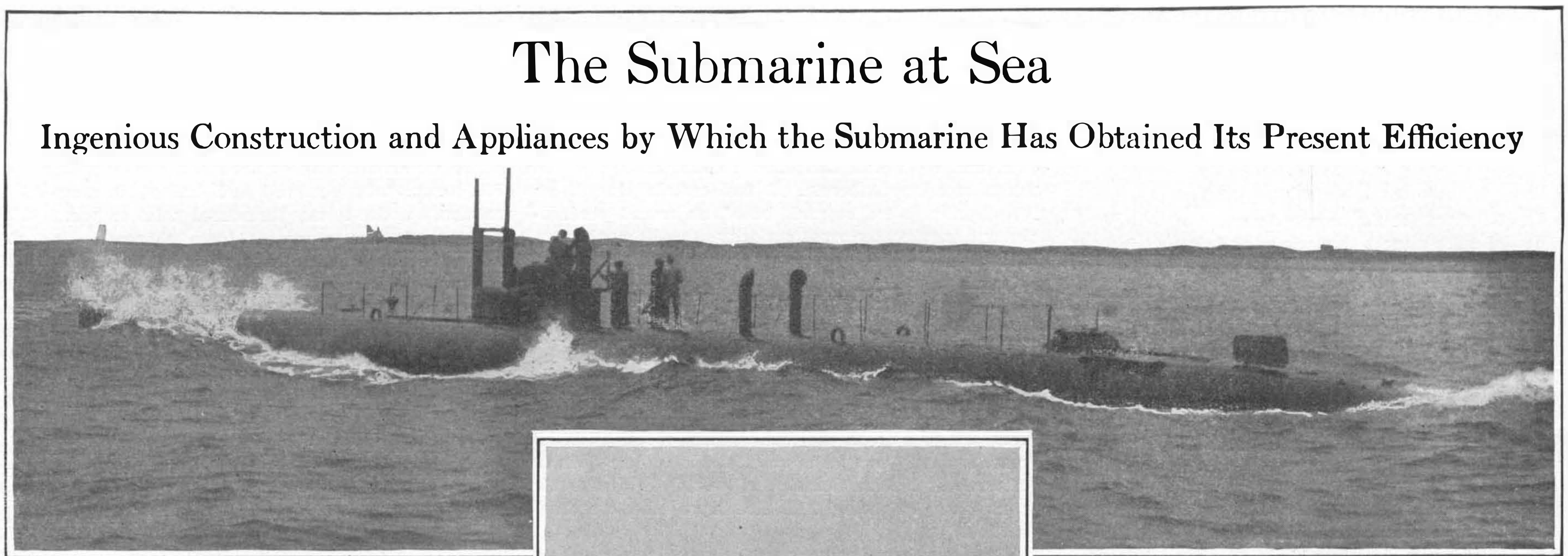
[There is a very distinct line of demarkation between the coast guard troops and the mobile army. The coast guard troops comprise some nineteen divisions when brought to full strength, and will be stationed in the vicinity of cities, naval bases, etc., and are intended as a defense against raiding parties from fleets.

A modern fleet is capable of landing several thousand men; it will be impossible to split up the mobile army (field army) with a view to protecting these many different points, all liable to attack by landing parties from the rear, and no portion of the 500,000 men less 40,000 coast artillery (approximately) could be sent to different seaports as coast defense troops without seriously crippling the field force. If this was attempted more than half the field force referred to above (500,000) would be required for this duty on the Atlantic coast alone. It will, therefore, be necessary to organize some nineteen coast guard divisions of all arms for this work, if both coasts are to be covered simultaneously.

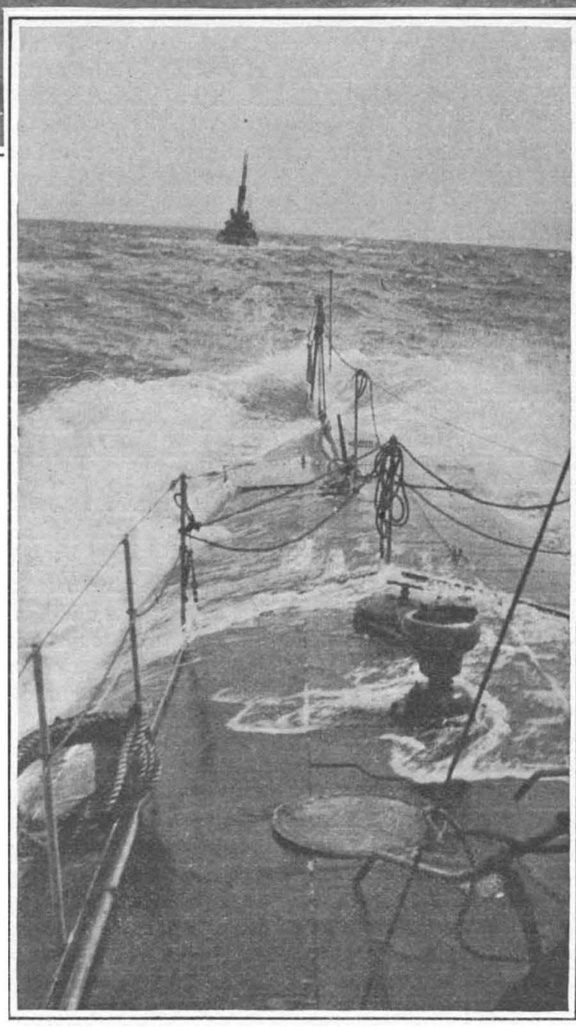
While coast guard troops are mobile troops, they are not organized into field armies, but are stationed in the force needed at the various points liable to attack. The organization of these troops is not in conflict with the organization of the land forces, but is a force which must be organized in addition to the force of 500,000 therein referred to, if important coast cities, harbors, naval bases, etc., are to be securely held.—EDITOR.]

# The Submarine at Sea

## Ingenious Construction and Appliances by Which the Submarine Has Obtained Its Present Efficiency



**The United States submarine "G-2" running full speed at the surface.**



**Driving into a choppy sea.**

ALTHOUGH there are various well-known types of submarine, they all have certain fundamental features in common. The present description applies broadly to any of the vessels of this type, but more particularly to those which at present compose the majority of the vessels of this class in the United States Navy.

The form of hull is generally described as cigar-shaped. It is built of the very best quality of mild steel, and the workmanship is of the highest order, for the reason that every seam and rivet must be perfectly tight, in view of the service which the boat is called upon to perform. Not only do vessels of this type undergo all the stresses of sea and weather which other vessels are subjected to, but, in addition, they are required to navigate at considerable depths below the surface of the water. At these depths the pressure of the water is great, so that the hull must be made sufficiently strong to withstand it.

About five years ago it was considered that the most efficient size for a boat was about 140 feet long and 14 feet in diameter. With such dimensions, a boat was built which fulfilled all requirements which the naval authorities of the world demanded from it. That is to say, it could cruise on the surface for long distances at a speed of fourteen knots. At lower speeds its radius of action extended to several thousand miles. Several boats of this class are in service in our Navy. For submerged work large storage batteries are provided, which furnish energy sufficient to drive the boat from ten to eleven knots for a period of over an hour. The same electrical energy will drive her at a lower speed for a much longer time. The later submarines are much larger. The "G-4" type of 1912 are 157 feet long by 17½ feet diameter and carry four 18-inch tubes. The Electric Boat Company have under construction a fine type, of which we give an illustration, which is of 265 feet length, 23 feet beam, with a surface speed of 11 to 15 knots and a maximum speed of 20 knots. The radius of action is from 3,500 to 6,000 miles, according to the speed. It will be armed with four torpedo tubes at the bow, two at the stern, and four on the deck, and it carries fourteen torpedoes.

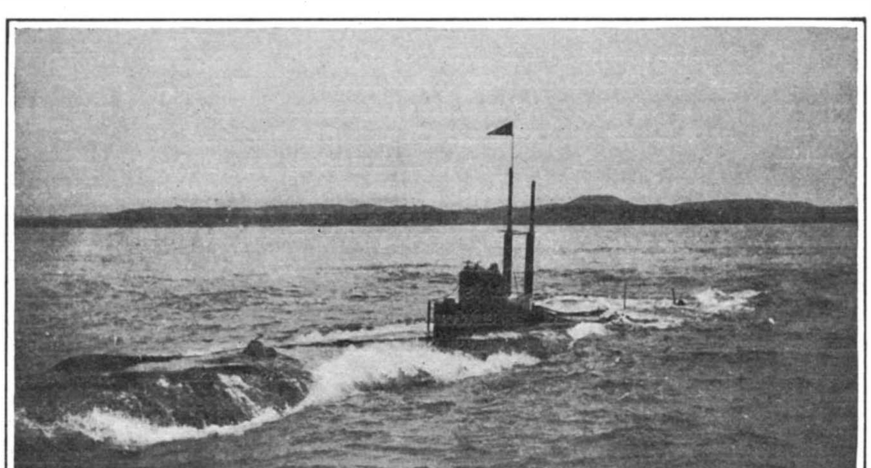
There are two distinct conditions in which the boat may be used. In the first, commonly known as the surface condition, the boat is prepared for cruising. A considerable portion of her hull is above water, a removable navigating bridge is in place, and she is driven by large, powerful, internal-combustion engines. Under these conditions she is managed in about the same way as any vessel built to run upon the surface. As for sea-going qualities, our submarines have been found in practice to be excellent. In ordinary weather they are fully as comfortable as any surface craft of the same dimensions, and even in the heaviest weather they are entirely seaworthy.

The second distinct condition exists when the boat is submerged. To pass from the surface to the submerged condition, certain valves in the interior of the boat are opened. This allows the water from the sea to run into great tanks built within the boat, and thus virtually sink her. These tanks are closely gaged, so that just the required amount of water is taken in. Under normal conditions, when the boat is at rest with the ballast tanks filled, she will have a few hundred pounds reserve buoyancy, which is represented by the top of her conning tower protruding above the water. If desired, this buoyancy may be entirely destroyed by admitting a small additional amount of water, equal in volume to the volume of that part of the conning tower above water. While in the submerged condition, all communication with the outside atmosphere is necessarily cut off. The crew then breathes the air contained in the body of the boat. The amount of air originally contained within the hull is sufficient to support life with comfort at least twenty-four hours. But, in addition to the air thus contained, the boat carries a large supply of compressed air in steel flasks, which, if used for breathing purposes, would be sufficient for a number of days.

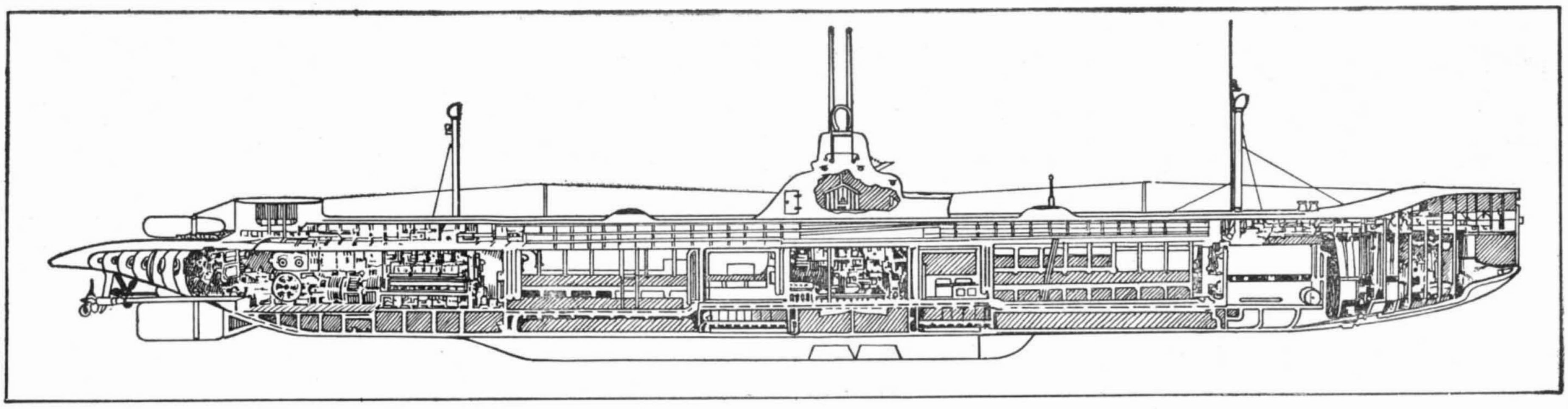
After having brought the boat to the submerged condition in the manner above described, powerful electric motors are started by throwing in a switch. These motors derive their energy from storage batteries contained in the boat and drive the propellers. The same storage batteries furnish current for numerous auxiliary motors used for pumping, steering, handling torpedoes, etc. The motion of the boat when under way is controlled by two sets of rudders; one of these sets, known as the vertical rudders, directs the boat's course to port or starboard just as does the rudder of an ordinary ship. In addition, there are provided horizontal rudders, which serve to control the motion of the boat in a vertical plane; that is to say, the depth at which she runs is regulated by these rudders. For steering in the horizontal plane, instruments are provided, so that the boat may be navigated with the same degree of accuracy as boats on the surface. The first of these instruments is known as a periscope. This consists of a vertical tube which extends from above the surface of the water to a few feet within the submarine. At the top of the tube is an object glass; at the bottom an eye-piece. Two reflecting mirrors, one at the top, the other at the bottom of the vertical tube, cause the image to be transferred from the object glass to the eye-piece. The operator can turn the periscope so as to sweep the whole horizon. To the writer, who once made a five-hour trip in one of our boats, the view was as clear as though he were at the surface looking through an ordinary field glass. Hence, when running submerged with the top of the periscope just out of the water, the navigator can see by day with perfect ease surrounding objects. If for any reason it should be desired to run at a still greater depth, compasses are provided by which the course may be steered with accuracy. For steering, submerged, in the vertical plane, instruments are provided which in a way take the place of the compass. One of these is a large pressure gage, which indicates the depth at which the boat is running. Another is a form of spirit level, which indicates the inclination of her axis. By the use of this, the man controlling the horizontal rudder is able to run at a perfectly even depth. While in the submerged condition, the boat is, of course, amply illuminated by electric lights. There are no ports or windows in the boat, and, so far as sensations are concerned, one is unable to determine whether he is running on the surface or submerged.

The arm of the submarine is the automobile torpedo. A number of these may be carried. They are discharged through tubes located in the bow or stern of the boat. Any type of automobile torpedo may be used. In view of the fact that the submarine is enabled to approach, unseen, to within a few yards, if desired, of the most powerful battleship, a long-range torpedo is not required. For this reason the weight devoted to motive power in the ordinary torpedo may be largely used to increase the charge of explosive, so that the destructive power can be made much greater for this particular type. Thus, the weapons used by the German submarines are credited with using the enormous charge of 420 pounds of explosive, and their range is about 1,200 yards.

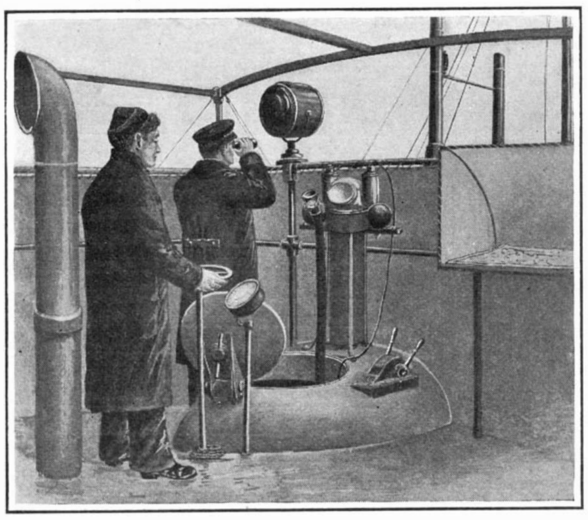
The present war afforded the submarine its first opportunity to exhibit its powers of offense; and it must be admitted that it has more than vindicated the faith and patience of its inventors. The roll of its victims is formidable. Early in the war a single German submarine, "U-9," sank within the hour three large British 12,000-ton armored cruisers. Later, a British battleship was torpedoed and sank in the English Channel. To this must be added a Turkish battleship and a long list of smaller cruisers and merchantmen.



**Lifting to a sea while running awash.**

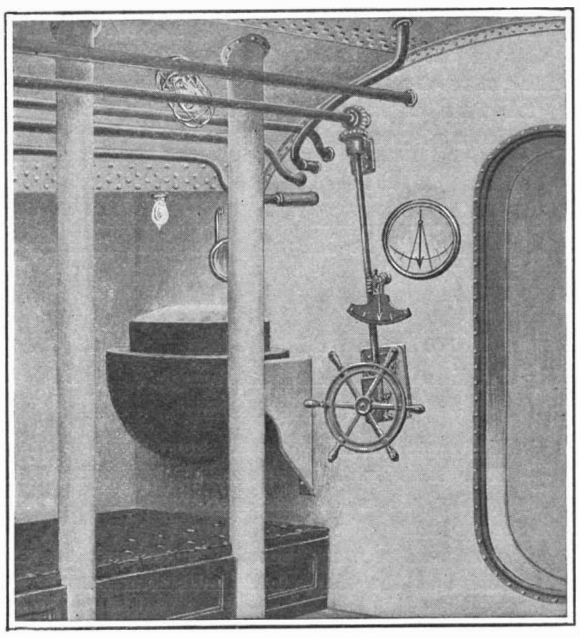


Longitudinal section through a typical German submarine.



**The bridge of U.S.S. "G-2."**

As fitted for surface cruising. This structure is made of portable parts, floor, stanchions, rails, steering wheel, compasses, chart table, searchlight and ventilator, all of which can be removed in a short time and stowed below decks or in the hollow superstructure, leaving nothing but the bare conning tower, as shown in the photographs.



**The navigating compartment of U.S.S. "G-2."**

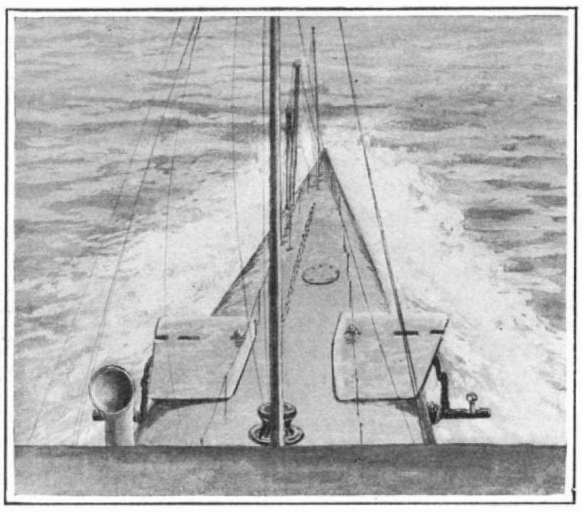
In this space all controls of the submarine are located. Our illusration shows the gyroscope compass, the steering wheel, the rudder indicator, and the indicator showing the roll of the vessel. The door leads into the torpedo room. In a very small amount of room a remarkable number of instruments must be ingeniously disposed in this manner.

## Teak Wood

THE consumption of teak has increased considerably during the last two decades. Besides its extensive employment in ship building in England and the manufacture of railway carriages in India, it is now used in increasing quantities in Europe for building purposes. The recent rapid growth of the European fleets has caused an enormously increased use of teak in spite of the marked tendency to employ as little wood as possible in the construction of warships. About 1,000 tons, or approximately half a million board feet, of the best grades of teak are used in the construction of a modern man-of-war. In order to replace the ships which have thus far been sunk or otherwise destroyed in the European war, hundreds of millions of feet will be required. This increased consumption of teak which is bound to follow the close of the present war, cannot be met by Burma and Siam. Formerly Burma alone supplied all the teak used by the English Admiralty, because it was considered better than that from Siam, but the demand for teak from both sources is likely to be very great, not only in Europe, but also in America, and prices are apt to rule very high.

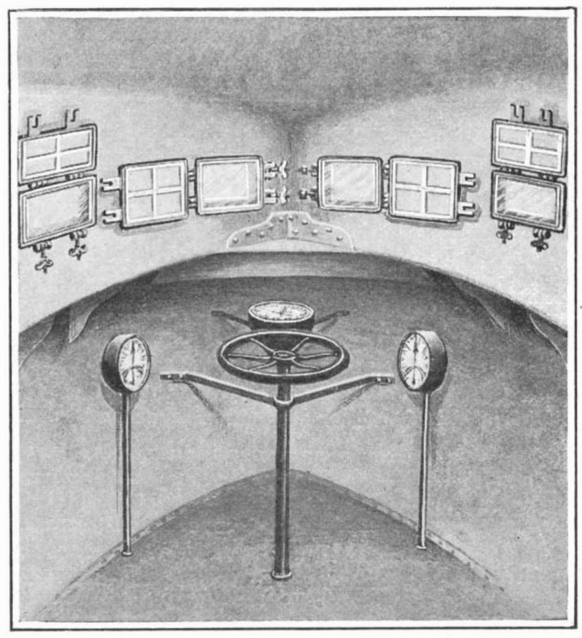
## Loco-weed Poisoning in Sheep

AS is well known, great uncertainty has always attached to the nature and precise origin of the so-called loco disease, which is commonly regarded as one of the great scourges of the Western cattle ranges, and is attributed to eating certain species of the genera *Astragalus* and *Aragallus* known as loco-weed. A recent contribution to this subject by H. T. Marshall, published in the *Bulletin* of Johns Hopkins Hospital, is based upon experiments in feeding *Aragallus spicatus* to sheep in Montana. The author finds that none of the abnormalities encountered in the sheep could be attributed to the weed, but were due either to insufficient food or to forms of parasitic infection. He is convinced that "there are several diseases of Western live stock masquerading under the general name 'loco disease,'" and says further, "I, therefore, think there is reason to be doubtful as to the existence of pure, *bona fide* loco-weed poisoning, and I hold that it is perfectly certain that the heavy losses attributed to loco-weed disease are at least in large measure due to other causes." These conclusions are not in accord with those of the *Bulletin* on loco-weed disease published a few years ago by the Bureau of Animal Industry, in which it is stated that "there is no longer any question in regard to the poisonous properties of the loco plants," and that the opinions prevailing among stockmen as to the symptoms of loco disease are quite correct. There is much other literature concerning this disease, access to which is most readily obtained through the indexes of the Experiment Station Record.



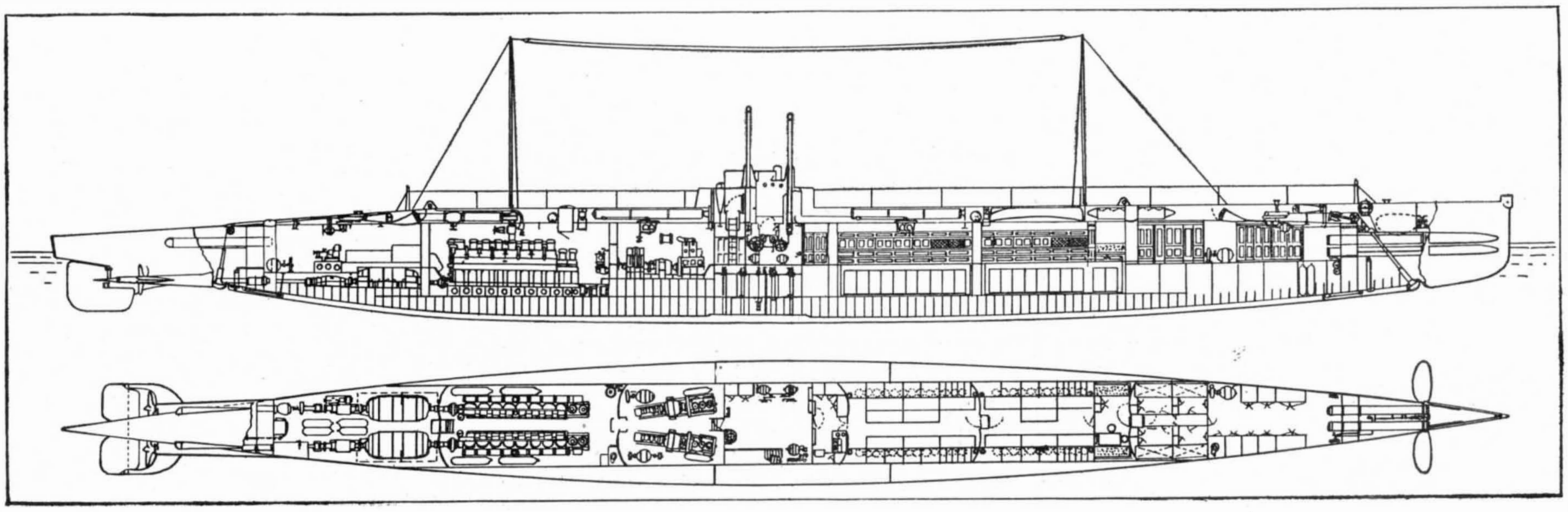
**Forward deck of U.S.S. "G-2."**

Showing two of the lateral planes or diving rudders bolted to the deck for surface running. The planes when operating for submerging are folded outward and lie horizontally on a shaft which is controlled from either the conning tower or operating room. The wireless mast is portable, and when the vessel is in submerging trim is lashed to the deck.



**In the conning tower of U.S.S. "G-2."**

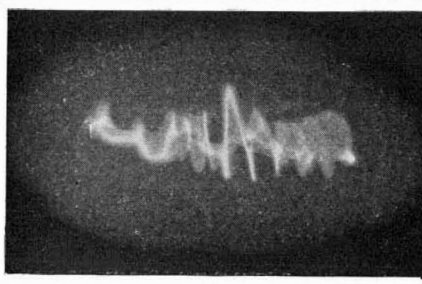
In this small compartment are duplicates of all gages, indicators, and operating devices with tell-tale connections to the main operating room. In the forward end, as shown, are four windows which give the navigator when the boat is running awash a view of the horizon. When totally submerged these ports are protected by steel shutters which are screwed tight.



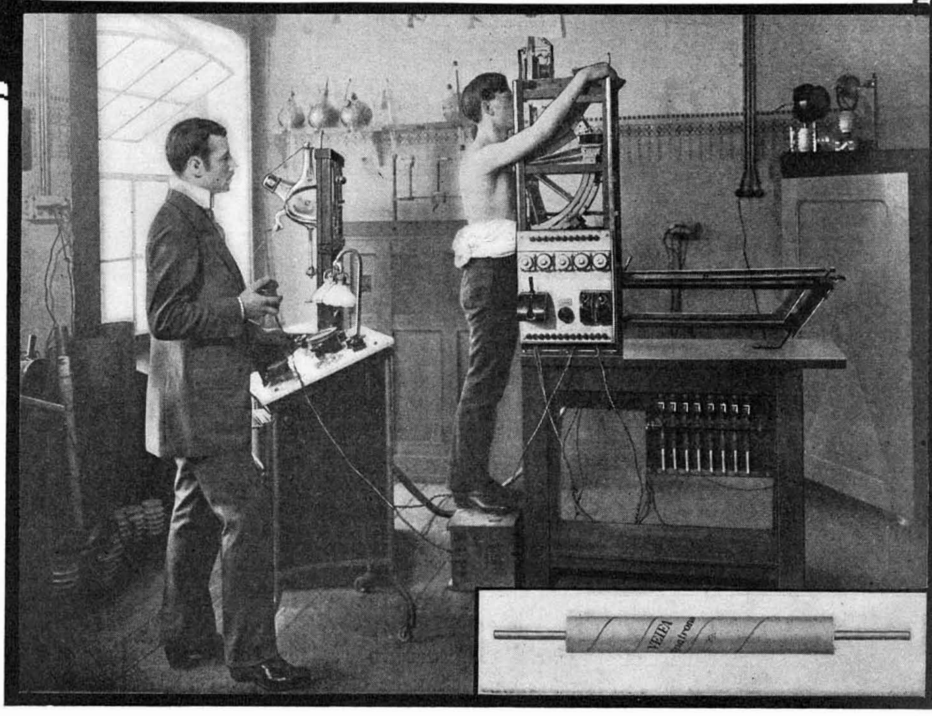
Longitudinal and plan views of a submarine of the Laurenti type.

# Röntgen Motion Pictures

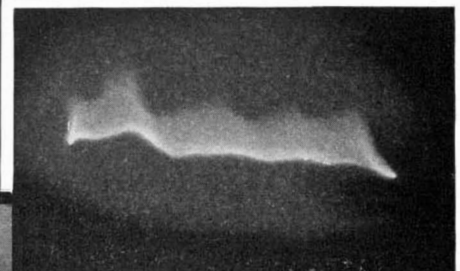
## The Remarkable Dessauer Process



In a magnetic field the secondary discharge acquires a spiral shape.



Dessauer's apparatus for taking eight snap-shot X-ray photographs per second. At the lower right-hand corner one of the "lightning cartridges," by means of which the sudden discharge through the Röntgen tube is produced.



The violent secondary discharge is like a long flaming tongue of light.

THE older forms of apparatus for preparing X-ray photographs of parts of the human body made use of a continuous discharge vacuum tube, and a more or less prolonged exposure of the photographic plate.

While this method is satisfactory enough for diagnosing fractures of bones, for example, it has a very obvious drawback when applied to most of the internal organs of the body. Some of these, as the lungs, the heart, and the alimentary canal have a proper motion of their own. Others, like the liver, follow the rhythmic contraction of the diaphragm. In all such cases a "time" exposure can give only a blurred image of the general shape of the organ, and fails to show sharp outlines. This defect is serious enough if all that is wanted is an approximate picture of the particular organ under examination. It is a complete bar to success if the actual motion of an organ, such as the heart, is to be observed. One of the first to point to this defect in the older method of X-ray photography was Dr. P. H. Eijkman of the Hague. Dr. Eijkman was making a radiographic study of the movements of the pharynx in the act of swallowing. With great patience he succeeded, by special devices, in obtaining the required views. But, as he pointed out at the time, the whole process would have been immensely simplified if he had had at his disposal means for taking a rapid succession of snap-shots.

The matter was taken up by Friedrich Dessauer of Frankfurt a/M., director of one of the largest X-ray tube works in the world, and well known for his valuable contributions especially to the applications of physics in therapeutics and surgery. Our readers may recall that we recently (SCIENTIFIC AMERICAN, July 11th, 1914, p. 30) had occasion to refer to his latest achievement, the production by means of an X-ray tube, of radiation practically identical with the gamma rays of radium.

It is most instructive to follow somewhat in detail the principles involved in the problem of X-ray kinematography and the argument followed by Dessauer in its solution.

It should be explained that, in order to produce the required effect upon a photographic plate, it is neces sary that a certain definite amount of energy reach the plate. Now with X-ray tubes as ordinarily employed, it required about one thousand impulses from the machine to furnish the requisite energy. The problem, then, was so to increase the energy of the discharge that a single impulse was sufficient to produce the image on the plate.

It is interesting to observe how this is accomplished by Dessauer. In the first place a very powerful induction coil is used. In ordinary practice a coil having an iron core weighing a few pounds is considered large. Dessauer's primary core weighs three hundredweight.

Now a core of this size requires an exceedingly heavy current to energize it, some 250 to 300 amperes. The problem, therefore, arises, how is this current to be drawn from ordinary electric mains? At clinics and private laboratories 20 to 40 amperes is usually about the limit of current available.

The way out of the difficulty is found by considering the time factor. The iron core requires four one hundredths of a second to be energized. If precautions are taken that the current shall under no circumstances last for longer than four hundredths of a second, it can, without damage to any part of the circuit, be taken from the ordinary electric mains. At the same time it is very essential that the interruption of the current be made as abrupt as possible.

These were the principles upon which the solution of the problem was based, and the Dessauer "lightning cartridge" constructed. The idea is to cause an explosive disruption of the circuit immediately after it is closed. The cartridge consists of a fine metal wire, one third of a millimeter thick, embedded in a plaster of paris matrix. When a heavy current is allowed to pass through this, the wire does not melt, but is gasified with explosive violence. This cartridge is inserted in series in the primary circuit of the induction coil. Measurements made on an apparatus of this construction showed a current of 400 milliamperes in the secondary. Ordinary X-ray apparatus employ a current of at most 10 milliamperes. The spark from the secondary is exceedingly violent, resembling a flame in appearance. If allowed to pass within the magnetic field of the primary it assumes a spiral twist as shown in our headpiece on the left.

The problem of X-ray snap-shot photography being thus solved, it now remained to construct an apparatus for making a number of exposures in rapid succession after the manner of the moving picture process. It was decided to use plates, and considerable difficulties were encountered in providing for the rapid intermittent motion of the parts, while yet avoiding all jerks. Finally, a device was evolved, which is shown in our central engraving at the head of this article. The plate is allowed to swing into place with a pendulum motion, and the exposure is made through automatic contacts at the moment when the plate hangs in its vertical position. This arrangement is preferable to one in which the plate moves laterally through the field, for any slight motion which takes place during exposure is in the direction in which the X-rays hit the plate, and, therefore, has practically no disturbing effects upon the definition. After exposure the plate falls down a chute, making way for the next plate to be exposed. Eight plates can thus be exposed in rapid succession in one second.

Some idea of the requirements to be met in photographing physiological subjects can be gained from an example. The heart normally beats about seventy-two times a minute, or in other words, completes one cycle in 0.85 of a second. As a matter of fact the contraction (systole) of the heart is much more rapid than its expansion (diastole), lasting only about one twentieth of a second. Inasmuch as some parts of the heart move through almost an entire inch, it will be seen what rapid exposure is needed to obtain a sharp representation of its action. One of our illustrations shows six exposures of the beating heart made during one cycle by the Dessauer process. Another set of photographs reproduced on the opposite page shows a kinematographic study of the act of swallowing. The photographs clearly show the motions of the food, of the tongue bone (hyoid bone), and the epiglottis (a cartilaginous lid that covers the larynx in swallowing, to prevent food from "going the wrong way").

It is needless to point out that X-ray pictures thus taken in rapid succession can be combined to reproduce as a moving picture the motion of the organ studied.

### Itakolumite, a Flexible Stone

WE are so accustomed to think of stone as something perfectly rigid—"hard as a stone" is a common expression—that it is difficult to conceive of a stone that is as flexible as India rubber. It is generally known, indeed, that thin sheets of mica and threads of asbestos possess some degree of flexibility and elasticity, but a thick stone plate that bends under its own weight is a rare and striking phenomenon, that is exhibited only by certain varieties of itakolumite. "Itakolumite," says *Prometheus*, "is a yellow or pale red sandstone of slaty structure, containing many little plates of mica, grains of talc and chlorite, and extremely fine particles of feldspar, with traces of iron pyrites, magnetite, and pure gold. It is the mother rock of Brazilian diamonds. In Brazil itakolumite is found in great masses, resting upon gneiss and associated with crystalline slates. Not all itakolumite is flexible. The flexible variety was first discovered in 1780. In view of the well-known properties of mica it is natural to ascribe the flexibility of itakolumite to the mica which it contains. Not a trace of flexibility, however, is exhibited by some varieties of itakolumite that contain very large proportions of mica. When flexible itakolumite is cut into thin plates and examined with a microscope it is found to be composed almost entirely of fine grains of sand of peculiar shape, with indented edges, which interlock like the fingers of the clasped hands. The flexibility of the material results from this interlocking of the grains of sand of which it is chiefly composed.

"A plate of itakolumite set on edge sways to and fro like a piece of leather. A thick plate supported at both ends bends so that it becomes concave above; if it is supported at its middle it becomes convex above. Smaller plates, an inch or more in thickness and 6 or 8 inches long, can be bent with the hands like strips of India rubber."

### More Mysteries of Ultra-violet Light

By Dr. Leonard Keene Hirshberg, A.B., M.A., M.D. (Johns Hopkins)

EVER since Prof. Becquerel showed the wonders of ultra-violet light, the science of physics has steadily day by day added more and more wonderful knowledge to the subject.

It was until recently thought that the curious chemical action of the ultra-violet radiations were peculiar to it; that negative and films and photographic plates were acted upon solely by the chemical powers of the ultra-violet light. Now, however, it is known that red, blue, infra-red, yellow, green, and the other kinds of light all have chemical powers of more or less strength. These chemical influences will also act upon a film or plate and yield a photograph.

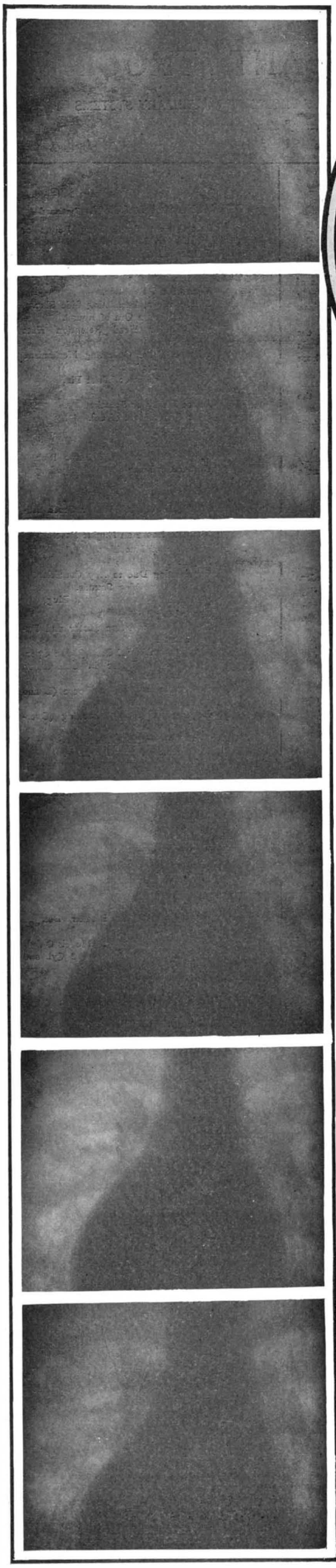
Recently much credence has been given to the proposal of such distinguished savants as Prof. Svante Arrhenius of Stockholm and Dr. Thomas S. Blair of Philadelphia that cosmic dust, shooting stars, meteors, comets, and the like carry life from planet to planet. That the germs of life of minute animals and plants have their origins in some such fashion as that.

Now it is known that the ultra-violet rays when directed for varying periods of time from an hour to several hours will kill all life. It is also realized and admitted by all physicists that outer space is permeated by ultra-violet light.

Therefore, say many who jump quickly, at conclusions, it is manifestly impossible for life to be transmitted from planet to planet and star to star as these noted investigators maintain.

Yet stop a while! Newer investigations just announced by the illustrious Dr. Alphonse Berget show that Dr. Blair, Prof. Arrhenius, Dr. Ecree, and others who hold that the specks of life are thus sent by the Creator from star to star are feasible in every way.

Ultra-violet light like gravitation is weaker and weaker the farther you get away from any spot. Therefore, 93,000,000 miles of separation between the sun and the earth weakens the ultra-violet rays very much. More-



Six successive exposures made during one heart beat. Such X-ray snapshots are remarkable for their sharp outlines.

Friedrich Dessauer.

over and this is the important point, the ultra-violet rays really act by "rusting," "burning," or "oxidizing" the things acted upon. That is to say they kill and exert a chemical action by virtue of the oxygen in the air.

Since there is no oxygen or atmosphere out in space, since it takes some hours for ultra-violet rays to kill; since also a meteor full of life bursts through the atmospheric corona or envelope of the earth in a flash, it follows that life could thus be transmitted through space without trouble to the scientific mind.

Further than this, Prof. Roux, another French research student, put living spores in a vacuum—a jar freed of all oxygen and air—and kept these minute living things exposed for six months to ultra-violet light, and they were alive at the end of this time.

All of which goes to show that it is not beyond the bounds of reason, religion, or raving to maintain that life came to the earth through the travels of scurring "vitality" from world to world on the saddle of comets, cosmic dust, and meteors.

## The Same Chemical Element May Have Different Atomic Weights

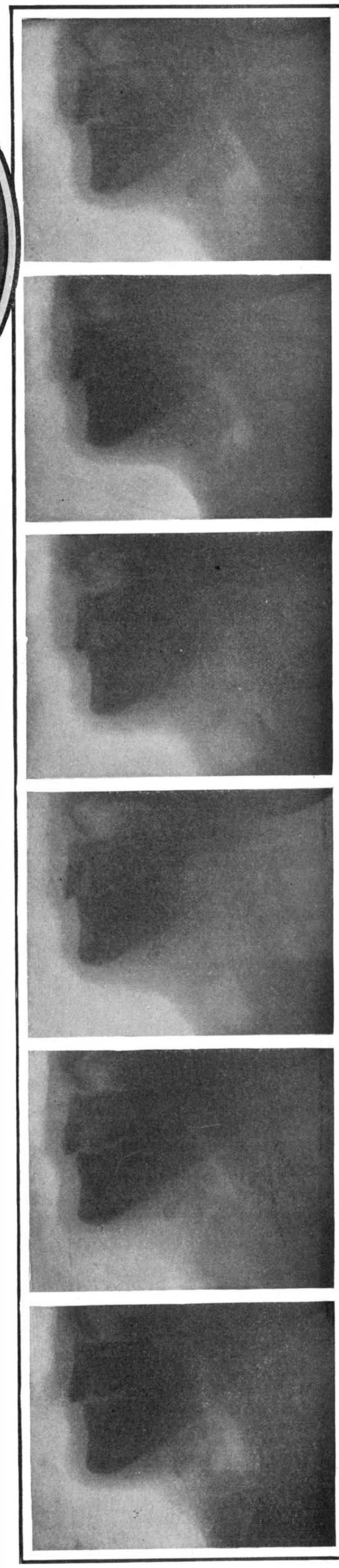
UNTIL recently it has been assumed that a given chemical element must always possess the same atomic weight, no matter from what mineral it is obtained. The inclusion of the radio-active elements in the periodic system, effected by Fajans and also by Soddy about a year ago, shows that we must assume the existence of elements which vary as much as 8 units in atomic weight, with corresponding variations in their radioactive properties (rays emitted, rate of decay, etc.), without any change in their chemical behavior. In reviewing the subject, *Umschau* observes that this conception was based on indirectly proved, or inferred, properties of the short-lived radioactive elements. Hence it was important to prove by direct experiment that two elements that appear chemically identical may have different atomic weights. The way to such an experimental demonstration was pointed out by Fajans, who concluded that the atomic weight of the lead formed in uranium ores, in the course of millions of years, as the final product of the disintegration of uranium, probably differs from the atomic weight of lead extracted from common lead ores.

This conclusion has now been confirmed experimentally by very careful determinations of the atomic weights of specimens of lead of diverse origins. The research was suggested by Fajans, and was carried out by his former assistant, Lembert, in the laboratory of Prof. Th. Richards in Harvard University, which is celebrated for its accurate methods of determining atomic weights. The atomic weight of lead obtained from uranium ores was found to be 206.6, while ordinary lead gave the distinctly different value 207.1.

The uncertainty attaching to these results is less than 0.02, and is consequently very much smaller than the observed difference. It is notable that these two varieties of lead appear to be identical, spectroscopically as well as chemically.

Analogous considerations make it appear probable that the lead of thorium ores also differs in atomic weight from common lead, but is atomically heavier than the latter. Possibly common lead is a mixture of uranium and thorium lead.

The question naturally arises whether the observed atomic weights of most elements are not merely mean values of the atomic weights of several elements which are chemically identical, and consequently not separable by chemical methods. The study of atomic weights, therefore, is confronted with a wholly new task—the investigation of the atomic weights of elements as affected by their origin.



The act of swallowing analyzed by six successive exposures. Here we have the beginning of a new kind of motion picture photography.

# LOCATION OF MOTORCYCLE POWER PLANT TROUBLES

**A COMPLETE CHART OUTLINING THE COMMON DERANGEMENTS THAT INTERFERE WITH PROPER ACTION OF ENGINE AND AUXILIARY SYSTEMS**

**Chart Arranged by VICTOR W. PAGÉ, M. E., Author of "Motorcycles, Side Cars and Cyclecars," Etc.**

## INSTRUCTIONS FOR USE

In preparing this chart, the author assumes that all parts mentioned or illustrated in the sectional drawing of complete motorcycle power plant can be easily identified by the rider on the machine he operates. Obviously, there are many forms of power plants used, all of which differ only in points of minor detail. The arrangement of the parts in accompanying illustration is typical, and is intended only as a guide to make possible the ready location or identification of similar parts on standard machines. A single cylinder motor is shown for simplicity, though twin cylinder motors are the most common.

Motorcycle power plant troubles can be easily identified by readily recognized symptoms, and the same symptoms are often produced by widely differing causes. The defective conditions more apt to obtain are enumerated in tabular form. In most cases the method of repairing the defect is apparent. Those not understanding the motorcycle mechanism sufficiently to be able to use this condensed statement of common troubles or those who do not know how to repair the defects enumerated, will find the elementary text-book, "Motorcycles, Side Cars and Cyclecars,"* which the chart supplements (printed by the same publisher) of value in getting complete knowledge of motorcycle construction, maintenance, operation and repair. The novice should attempt to locate any trouble systematically and the logical enumeration of defective conditions should help him as well as the more expert.

For example, if the motor runs irregularly this condition is apparent at once. The points needing inspection are enumerated under that head, and if followed systematically the trouble can be found by elimination, even by the inexpert. The common troubles are all classed under easily recognized main symptoms, such as Lost Power, Noisy Operation, etc.

## MOTOR WILL NOT START OR STARTS HARD

a—Defects in Motor Mechanism.
- Seized Piston, or Dry Piston.
- Piston Rings Gummed to Cylinder.
- Valve Stuck (Automatic Inlet).
- Valve Gears Out of Time.
- Broken Connecting Rod or Crankpin (Rare).
- Broken Exhaust Valve Spring.
- Broken Inlet Valve Spring.
- Broken Valve Push Rod.

b—Fuel System Faults.
- No Gasoline in Tank.
- No Gasoline in Carburetor Float Chamber.
- Tank Shut-Off Closed.
- Clogged Filter Screen.
- Fuel Supply Pipe Clogged.
- Gasoline Level Too Low.
- Gasoline Level Too High (Flooding).
- Bent or Stuck Float Lever.
- Loose or Defective Inlet Manifold.
- Auxiliary Air Valve Spring Broken.
- Not Enough Gasoline at Jet.
- Punctured Metal Float (Causes Flooding).
- Fuel Soaked Cork Float (Causes Flooding).
- Water in Carburetor Spray Nozzle.
- Dirt in Float Chamber.
- Too Much Primary Air.
- Carburetor Frozen (Winter Only).

c—Ignition System Troubles.
- Loose Terminal.
- Magneto Ground Wire Shorted.
- Magneto Defective (No Spark at Plugs).
- Broken Spark Plug Insulation.
- Carbon Deposits or Oil Between Plug Points.
- Spark Plug Points Too Near Together or Far Apart.
- Wrong Cable to Plugs (Twin or 4 Cyl. Motors).
- Short Circuited Secondary Cable.
- Broken Secondary Cable.

Battery Ignition System Only:
- Battery Weak.
- Poor Contact at Timer.
- Timer Points Dirty.
- Poor Contact at Switch.
- Primary Wires Broken or Short Circuited.
- Battery Grounded in Metal Container.
- Battery Connectors Broken.
- Timer Points Out of Adjustment.
- Defects in Induction Coil.

- Ignition Timing Wrong, Spark Too Late or Too Early.
- Defective Platinum Points in Breaker Box (Magneto).
- Points Not Separating.
- Broken Contact Maker Spring.
- No Contact at Secondary Collector Brush.
- Platinum Contact Points Burnt or Pitted.
- Contact Breaker Bell Crank Stuck.
- Fibre Bushing in Bell Crank Swollen.
- Short Circuiting Spring Always in Contact.
- Dirt or Water in Magneto Casing.
- Oil in Contact Breaker.
- Oil Soaked Brush and Collector Ring.
- Distributor Filled With Carbon Particles (4 Cylinder Magnetos).

## MOTOR STOPS WITHOUT WARNING

- Broken Plug Wire (Single Cylinder).
- Broken Magneto Carbon Brush.
- Gasoline Shutoff Valve Jarred Closed.
- Gasoline Supply Pipe Clogged.
- No Gasoline in Tank.
- Spray Nozzle Stopped Up.
- Water in Spray Nozzle.
- Particle of Carbon Between Spark Plug Points.
- Magneto Short Circuited by Ground Wire.
- Air Lock in Gasoline Pipe.
- Broken Spark Plug Insulation.
- Inlet or Exhaust Valve Stuck Open.
- Piston Seized on Account of Defective Oiling.
- Bent or Broken Connecting Rod or Crankshaft (Rare).

MOTOR STOPS WITHOUT WARNING.—*Continued*

- Broken Roller or Ball Bearing in Motor (Rare).
- Seized Main Bearings (Plain Bronze Bushings Only).
- Water on High Tension Magneto Terminal.
- Spark Plug Cable Burnt Through by Hot Exhaust Pipe.
- Insufficient Lubrication.
- Flywheels Wedged by Foreign Matter in Engine Base.
- Magneto Out of Time, Due to Slipping Drive.
- Sheared Key in Cams or Valve Operating Mechanism.
- Water or Oil in Safety Spark Gap (Four Cyl. Magneto).

## MOTOR STOPS GRADUALLY

- Fuel Supply Pipe Partially Clogged.
- Air Vent in Tank Filler Cap Stopped Up.
- Float Needle Valve Stuck.
- Water or Dirt in Spray Nozzle.
- Mixture Adjusting Needle Jarred Loose.
- Air Valve Stuck Open.
- Loose Terminal at Plugs.
- Valves Stuck Open.
- Motor Overheating Due to Defective Oiling.
- Spark Advance Rod Broken.
- Throttle Rod Breaks.

## MOTOR RACES

- Control Wires or Rods Broken.
- Auxiliary Air Valve Stuck Open.
- Defective Induction Pipe Joint.
- Leaky Valve Dome Packing.
- Throttle Not Closing.
- Magneto Contact Breaker Stuck in Advance Position.
- Clutch Slips (Chain or V Belt Drive).
- Belt Slips (Flat Belt Drive).
- Chain or Belt Broken.
- Sprocket or Pulley Driving Key Sheared Off.

## MOTOR WILL NOT SPEED UP

- Auxiliary Air Valve Stuck Closed.
- Piston Binding in Cylinder.
- Not Enough Oil in Engine Base.
- Bent or Sticking Valve Stem.
- Too Much Play in Valve Operating Levers.
- Too Much Space Between Valve Stems and Push Rods.
- Valves Timed Late.
- Spark Timed Late.
- Throttle Stuck Closed.
- Magneto Contact Breaker Stuck in Retard Position.
- Worn Fibre Block in Magneto Contact Breaker.
- Binding Fibre Bushing in Contact Breaker Bell Crank.
- Dragging Brakes.
- Front or Rear Hub Bearings Too Tight.
- Wheel Bearings Broken.
- Driving System Parts Not in Alignment.
- Gear Ratio Too High.

## MOTOR WILL NOT STOP

- Throttle Remains Open.
- Spark Interrupting Switch Out of Order.
- Incandescent Carbon Deposits Fire Charge.

## MOTOR SPEEDS UP SUDDENLY

- Break in Chain or Belt.
- Clutch Slipping or Released.
- Chain Has Jumped Sprockets.
- Flat Belt Slipping.
- Throttle Has Jarred Open.

## MOTOR RUNS IRREGULARLY OR MISFIRES

a—Defects in Motor Mechanism.
- Carbon Deposits in Combustion Chamber.
- Weak or Broken Valve Springs.
- Stuck Valve Stems.
- Carbon Under Valve Head.
- Worn Push Rod or Guide.
- No Clearance Between Valve Stem and Plungers.
- Air Leak in Inlet Piping.
- Broken Gasket Under Valve Dome.
- Air Leak Through Inlet Valve Guide (L Head).

b—Faults in Fuel Supply System.
- Carburetor Float Chamber Getting Dry.
- Water or Dirt in Gasoline.
- Air Valve Spring Weak or Broken.
- Poor Gasoline Adjustment.
- Poor Air Valve Adjustment.
- Not Enough Gasoline in Float Chamber.
- Too Much Gasoline, Carburetor Flooding.

c—Ignition System Faults.
- Loose Wiring or Terminals.
- Broken Spark Plug Insulator.
- Spark Plug Points Sooted or Oily.
- Wrong Spark Gap at Plug Points.
- Leaking Secondary Cable.
- Prematurely Grounded Primary Wire.
- Batteries Running Down (Battery Ignition Only).
- Poor Adjustment of Contact Points at Timer.
- Wire Broken Inside of Insulation.
- Loose Platinum Points in Magneto.
- Weak Contact Spring (Battery Timer Only).
- Broken Collector Brush.
- Dirt in Magneto Casing or Contact Breaker.
- Worn Fibre Block or Cam Plate in Magneto.
- Worn Cam in Timer (Battery System Only).

## MOTOR NOISY IN ACTION

a—Mechanical Depreciation Producing Knocking.
- Foreign Matter in Engine, Such as Loose Nut in Engine Base.
- Carbon Deposits in Combustion Chamber.

MOTOR NOISY IN ACTION.—*Continued.*

- Incandescent Spark Plug Points or Carbon Particles.
- Loose Wrist Pin Bearing.
- Loose Connecting Rod Big End Bearing.
- Worn Main Bearings.
- Piston Worn, Permitting Side Slap.
- Cylinder Worn Out of Round.
- Cylinder or Head Retention Nuts Loose.
- Play in Valve Operating Mechanism.
- Timing Gears Worn.
- Bent Crank Pin or Wrist Pin.
- Loose Flywheels.
- Loose Pulley or Sprocket.
- Poor Oil or Lack of Oil.
- Piston Rings Tight.

b—Mixture Troubles.
- Too Much Gasoline, Mixture Rich.
- Carburetor Float Chamber Flooding.

c—Ignition Trouble.
- Spark Timed Too Early.
- Magneto Contact Breaker Stuck Advanced.
- Magneto Loose on Engine Base.

d—Other Causes of Knocking.
- Engine Geared Too High.
- Overheating Due to Any Condition.

e—Hissing and Squeaking Sounds.
- Broken Insulation on Spark Plug.
- Spark Plug Leaks.
- Loose Joint Between Motor and Exhaust Pipe.
- Compression Relief Cock Jarred Open.
- Valve Dome Loose in Combustion Chamber.
- Valve Chamber Covers Loose (L and T Head Motors).
- Leaking Valve Cage Packing (Overhead Valve Motors).
- Poor Lubrication (Causes Squeaking).
- Muffler Leaking or Ruptured.
- Broken Piston Rings (Blowing Sound).
- Tight Piston Rings (Scraping Sound).

f—Popping or Blowing Back in Carburetor.
- Incorrectly Timed Inlet Valve.
- Inlet Valve Not Seating.
- Defective Inlet Valve Spring.
- Dirt Under Inlet Valve Seat.
- Defective Auxiliary Air Valve (Admits Too Much Air).
- Not Enough Gasoline (Open Needle Valve).
- Spark Retarded Too Much.
- Contact Points in Breaker Box or Timer Pitted.
- Weak Batteries (Battery Models Only).
- Wrong Cables to Plugs (2 Cyl. and 4 Cyl. Motors).

g—Muffler Explosions.
- Mixture Not Exploding Regularly.
- Exhaust Valve Sticking.
- Dirt Under Exhaust Valve Seat.
- Wrong Cables to Plugs (2 Cyl. and 4 Cyl. Motors).

h—Grinding Noises.
- Worn Timing Gears.
- Defective Cylinder Lubrication.
- Worn Driving Chains.
- Worn Two-Speed Gearing.

## MOTOR LOSES POWER

a—Causes of Poor Compression.
- Loose Spark Plug.
- Defective Cylinder Head Gasket.
- Cracked Piston or Cylinder.
- Leaky Valves (Regrind).
- Warped Valve Heads.
- Piston Ring Joints in Line.
- Inlet Valve Dome Loose on Cylinder.

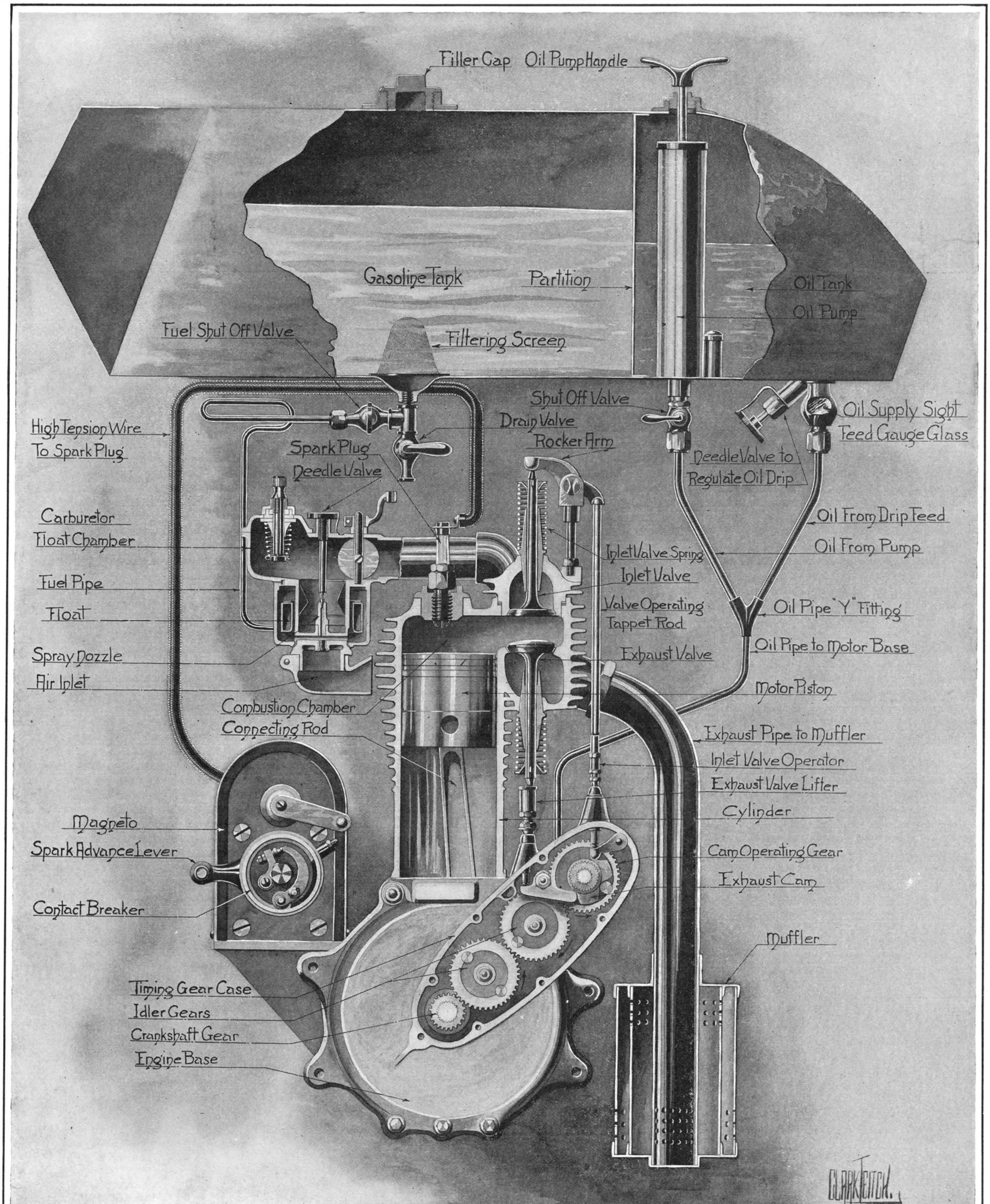
b—Other Causes of Lost Power.
- Exhaust Valve Lift Insufficient.
- Inlet Valve Lift Insufficient.
- Choked Muffler.
- Carbon Deposits.
- Tight Bearings.
- Cylinder Dry or Overheated.
- Oil Too Light.
- Oil Too Heavy.
- Oil Carbonizes at Too Low Temperature.
- Overheating Due to Driving With Retarded Spark.
- Overheating Due to Racing Motor on Low Speed Gear.
- Overheating Due to Too Rich Mixture.
- Oil Feed Interrupted.
- Defective Oil Pump.

Note.—All causes contributing to irregular motor action also produce lost power.

* Published by Munn & Co., Inc.

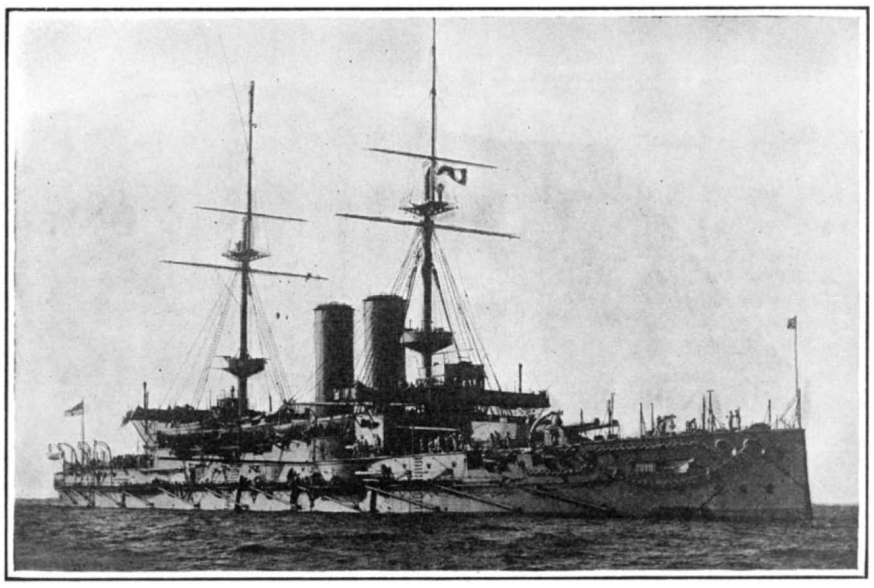
# A TYPICAL SINGLE-CYLINDER ENGINE OF A MOTORCYCLE

**TWIN CYLINDER MOTORS ARE THE MOST COMMON, BUT A SINGLE-CYLINDER IS SHOWN FOR THE SAKE OF SIMPLICITY**

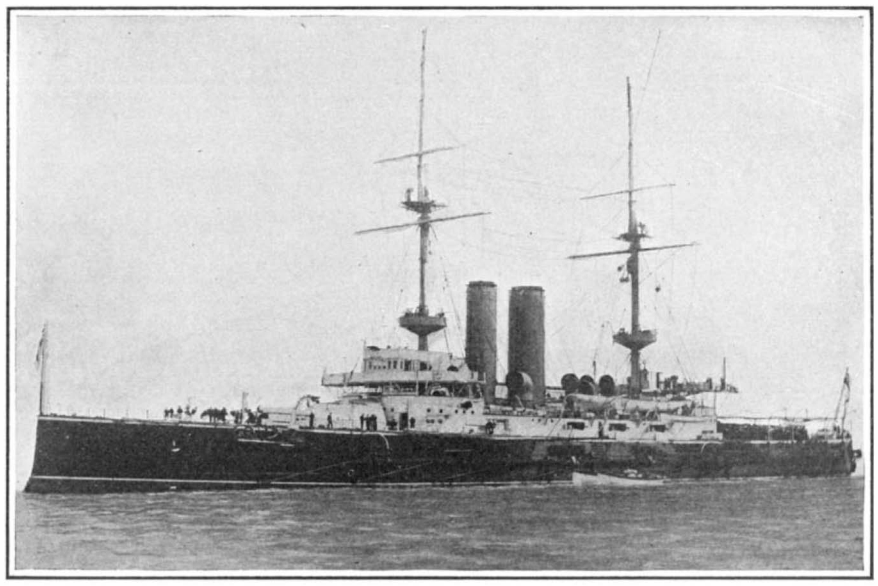


# Forcing the Dardanelles

## Floating Mines and Gunfire Work Havoc on the Allied Fleet



British battleship "Irresistible," sunk in the Dardanelles.



British battleship "Ocean," sunk in the Dardanelles.

THE certainty of heavy losses when a fleet engages strong shore batteries, particularly if, as in the case of the Dardanelles, it is necessary to come within effective range of the guns and operate in confined waters where maneuvering is difficult, was proved in the engagement which took place between the allied French and British fleets on the 18th of March.

In our last description of the Dardanelles and the operations to take the forts, we outlined the methods by which the reduction of the latter is being attempted, namely, by indirect fire across the Gallipoli Peninsula, assisted by observation from ships properly stationed for the purpose, and by direct fire from ships within the straits after the forts guarding the entrance had been reduced.

When the fire of the 15-inch guns of the "Queen Elizabeth" had silenced the guns of the most heavily armed forts at the Narrows and the shore batteries had also been silenced by the direct fire of ships that had entered the straits, heavy mine-sweeping operations were carried on, much of it under heavy fire from the enemy, with a view to clearing the way for the approach of the fleet, for reducing, in detail, the heavy forts on both sides of the Narrows.

The Admiralty statement covering the great battle of the 18th of March is as follows:

"Mine-sweeping having been in progress during the last ten days inside the straits, a general attack was delivered by the British and French fleets yesterday (Thursday) morning upon the fortresses at the Narrows.

"At 10:45 A. M. the 'Queen Elizabeth,' 'Inflexible,' 'Agamemnon,' and 'Lord Nelson' bombarded Forts J, L, T, U, and C, while the 'Triumph' and 'Prince George' fired at Batteries F, E, and H. A heavy fire was opened on the ships from the howitzers and field guns.

"At 12:22 o'clock the French squadron, consisting of the 'Suffren,' 'Gaulois,' 'Charlemagne,' and 'Bouvet,' advanced up the Dardanelles and engaged the forts at closer range. Forts J, U, F, and E replied strongly. Their fire was silenced by the ten battleships inside the straits, all the ships being hit several times during this part of the action.

"By 1:25 P. M. all the forts had ceased firing. The 'Vengeance,' 'Irresistible,' 'Albion,' 'Ocean,' 'Swiftsure,' and 'Majestic' then advanced to relieve the six old battleships inside the straits.

**"Bouvet" Sunk, then Two British.**

"As the French squadron, which had engaged the forts in a most brilliant fashion, was passing out the 'Bouvet' was blown up by a drifting mine. She sank in 36 fathoms north of Erenkeui village in less than three minutes.

"At 2:36 P. M. the relief battleships renewed the attack on the forts, which again opened fire. The attack on the forts was maintained while the operations of the mine sweepers continued.

"At 4:09 P. M. the 'Irresistible' quitted the line, listing heavily, and at 5:50 o'clock sank, having probably struck a drifting mine. At 6:05 o'clock the 'Ocean,' also having struck a mine, sank.

"Both vessels sank in deep water, practically the whole of their crews having been removed safely under a hot fire.

"The 'Gaulois' was damaged by gunfire. The 'Inflexible' had the forward control position hit by a heavy shell and required repair.

"The bombardment of the forts and the mine-sweeping operations terminated when darkness fell. The damage to the forts, effected by the prolonged direct fire of the very powerful forces employed, cannot yet be estimated, and a further report will follow.

**Mines Brought by Current.**

"The losses of the ships was caused by mines drifting with the current which were encountered in areas hitherto swept clear, and this danger will require special treatment.

"The British casualties in the *personnel* were not heavy, considering the scale of the operations, but practically the whole of the crew of the 'Bouvet' were lost with the ship, an internal explosion having apparently supervened on the explosion of the mine.

"The 'Queen' and the 'Implacable,' which have been dispatched from England to replace the ships' casualties, in anticipation of this operation, are due to arrive immediately, thus bringing the British fleet up to its original strength. The operations are continuing with the naval and military forces available on the spot.

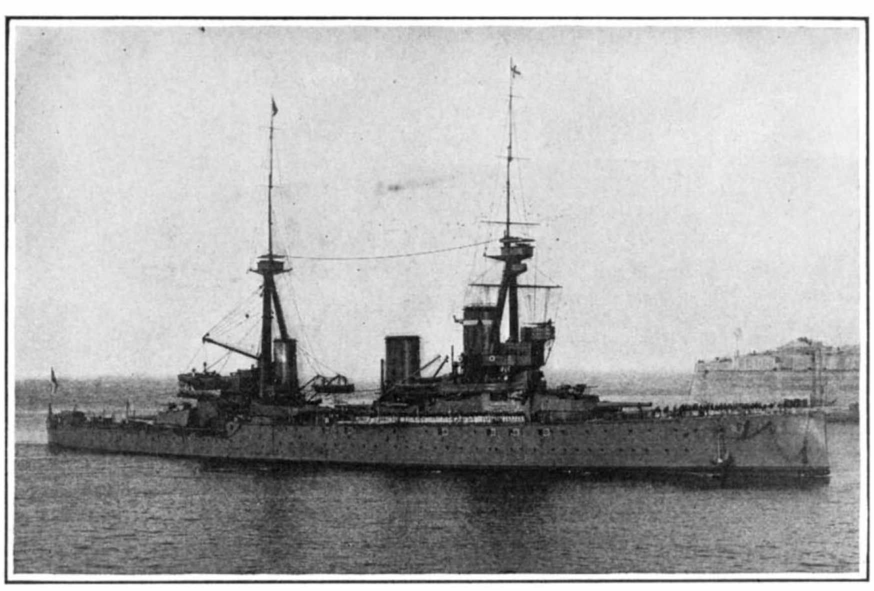
**Admiral De Robeck Now Commands.**

"On the 16th instant, Vice Admiral Carden, who had been incapacitated by illness, was succeeded in the chief command by Rear Admiral John Michael de Robeck, with the acting rank of Vice Admiral."

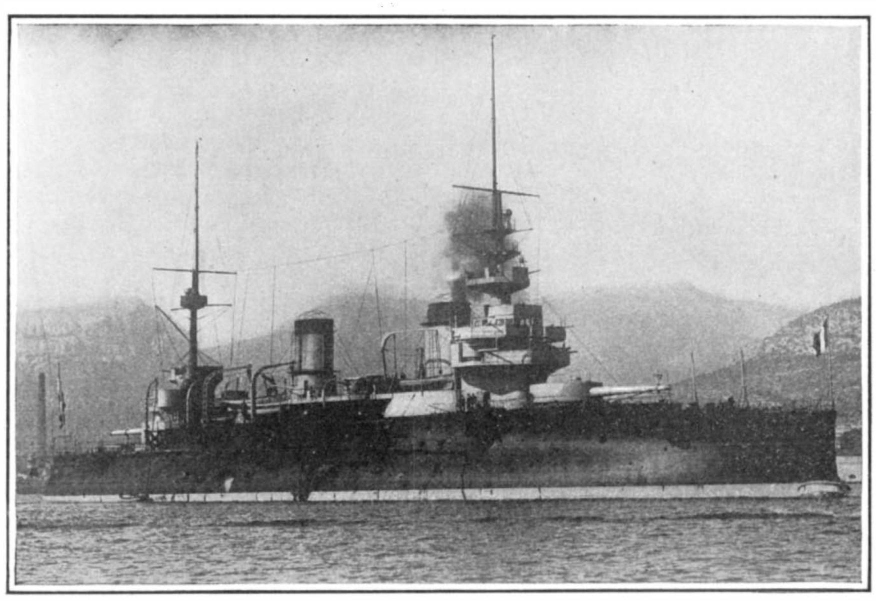
Subsequent observation by aeroplanes flying at a low altitude proved that the tremendous bombardment by the fleet had been very effective, some of the forts being described as being knocked entirely to pieces. On the other hand, it must be admitted that the fleet paid a heavy toll for its daring to attempt the supposedly impossible. The British lost three battleships and the French one, while the battle-cruiser "Inflexible" and the battleship "Gaulois" were damaged by shells from the Turkish forts. The four battleships which went down were all old vessels, the "Irresistible" having been completed in 1902, the "Ocean" in 1900, and the French "Bouvet" in 1896. The flagship "Inflexible," a battle-cruiser completed in 1908, was struck by a heavy shell in the forward control station, and the old French battleship "Gaulois," completed in 1895, was also badly damaged, both this ship and the "Inflexible" being put out of action until repairs can be effected.

The loss of these ships was due to the setting afloat by the Turks of a large number of floating mines, which, carried down through the straits by a current which, at certain states of the tide, runs sometimes as fast as five knots, are a constant menace to the attacking fleet. These mines are not to be confused with those which are anchored and are removed by mine-sweeping. Against the floating mines the only defense is carefully to watch for them, and, when they are detected, destroy them at once by shell fire, or else tow them by small boats to the side of the channel out of the way of the ships.

The claim of the Allies that they have inflicted heavy damage on the forts is flatly contradicted by dispatches from Turkish and German quarters in Constantinople. These state that the fire of the fleet, powerful and long-continued though it was, failed to do any serious damage to the batteries. The claim is made that the shells exploded, for the most part, harmlessly in the earthworks, and that much of the fire, because of the smoke and dust, was inaccurate. One interesting development has been the re-enforcement of the defenses by field guns and howitzers, mounted on shore railways.



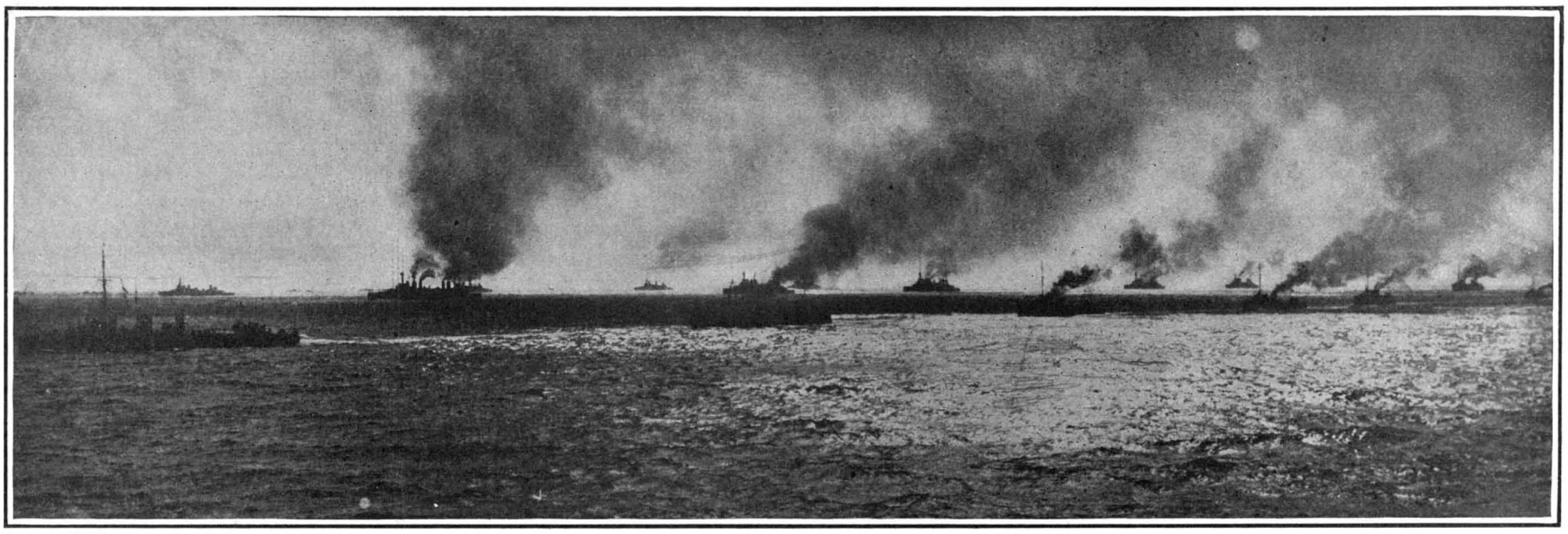
Battle-cruiser "Inflexible," disabled in the Dardanelles attack.



French battleship "Bouvet," sunk in the Dardanelles.

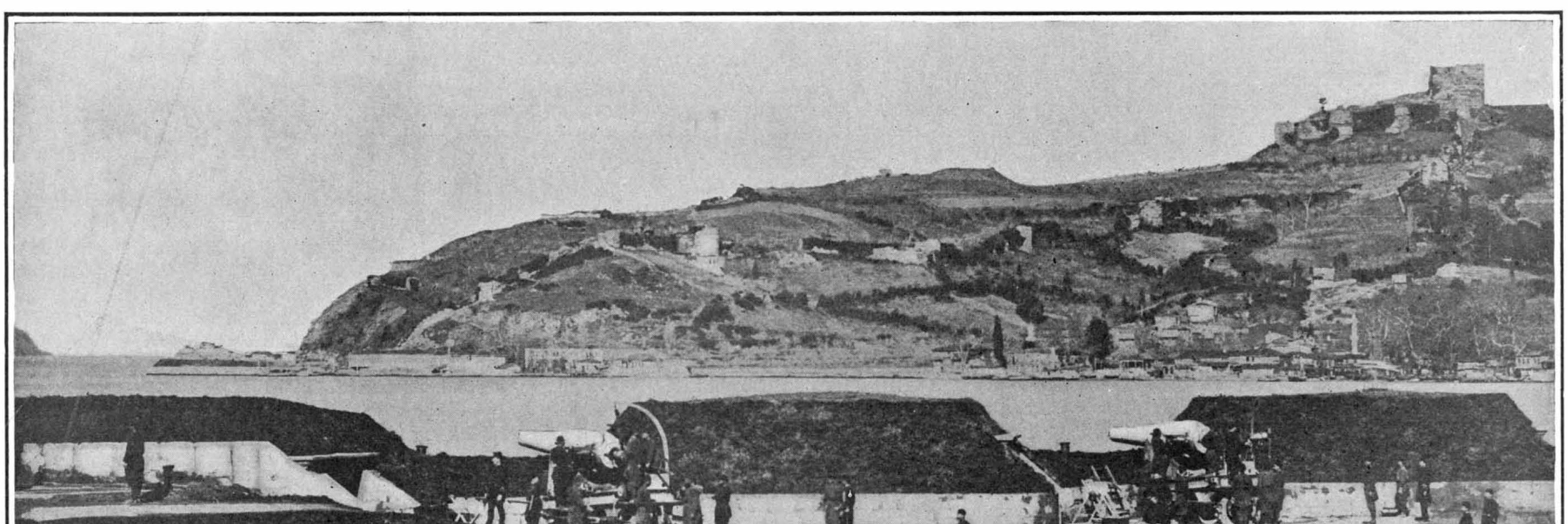
Copyright by Underwood & Underwood.

A panoramic view of Constantinople, the objective of the fleets now engaged in the Dardanelles.



Copyright by Underwood & Underwood.

The Allied fleet operating against the Dardanelles. Photograph taken from the French battleship "Bouvet."



Copyright by Underwood & Underwood.

An obsolete battery in one of the older Dardanelles forts.

# The Heavens in April

## Nebulæ; Their Nature, Dimensions and Distances from Us

By Henry Norris Russell, Ph.D.

AMONG the most difficult of the yet unsolved problems of astronomy is that of the distances, dimensions, and nature of the nebulæ. Thousands of these hazy patches of light are visible with telescopes of no exceptional power, and the number which could be photographed with great telescopes, if time was available, to take the whole heavens with long exposures, must be fully 150,000, as was told in these columns a year ago.

It has been known since the dawn of spectroscopic investigation that the nebulæ, when studied by this powerful method of research, fall sharply into two classes—the "green nebulæ" (as Prof. Young called them), whose spectrum shows that their light comes almost entirely from rarefied gases, and the "white nebulæ," which for many years refused to yield any clear evidence of their nature to the visual observations of even the keenest observers.

Half a dozen years ago photography solved the riddle by showing that spectra of these white nebulæ were essentially similar to that of the Sun or of other stars. This left two theories of their nature open; either they were single stars, enveloped in a dense fog of some sort which concealed the central body but reflected its light, or they were vast clusters of stars, too remote, too faint, and too close together in the sky to be seen separately, even in great telescopes, just as the star clouds in the Milky Way look to the naked eye like continuous masses of light.

But, though we have thus known for some time a little of the probable constitution of the nebulæ, we have been, till within little more than a year or so, utterly in the dark concerning their distances and real dimensions. Since they are practically fixed in the heavens, showing far less "proper motion" than the nearer stars, we could be fairly sure that they were farther off than these, our nearest cosmic neighbors, but beyond this there was little to say.

Toward the close of 1913, however, Dr. Slipher of the Lowell Observatory announced that he had secured spectrograms of the Great Nebula in Andromeda, which showed that it was approaching us at the unprecedentedly great radial velocity of 300 kilometers per second, and in a later communication, recently published, he reports measures on other white nebulæ, of spiral form, which are even more remarkable. One nebula in Virgo is receding at the tremendous rate of 1,100 kilometers, or nearly 700 miles, per second, and the average velocity, in the line of sight, of the fifteen objects so far observed, is fully 400 kilometers per second, which is about twenty-five times the average rate of motion of the thousand or more individual stars which have been observed spectroscopically in similar fashion.

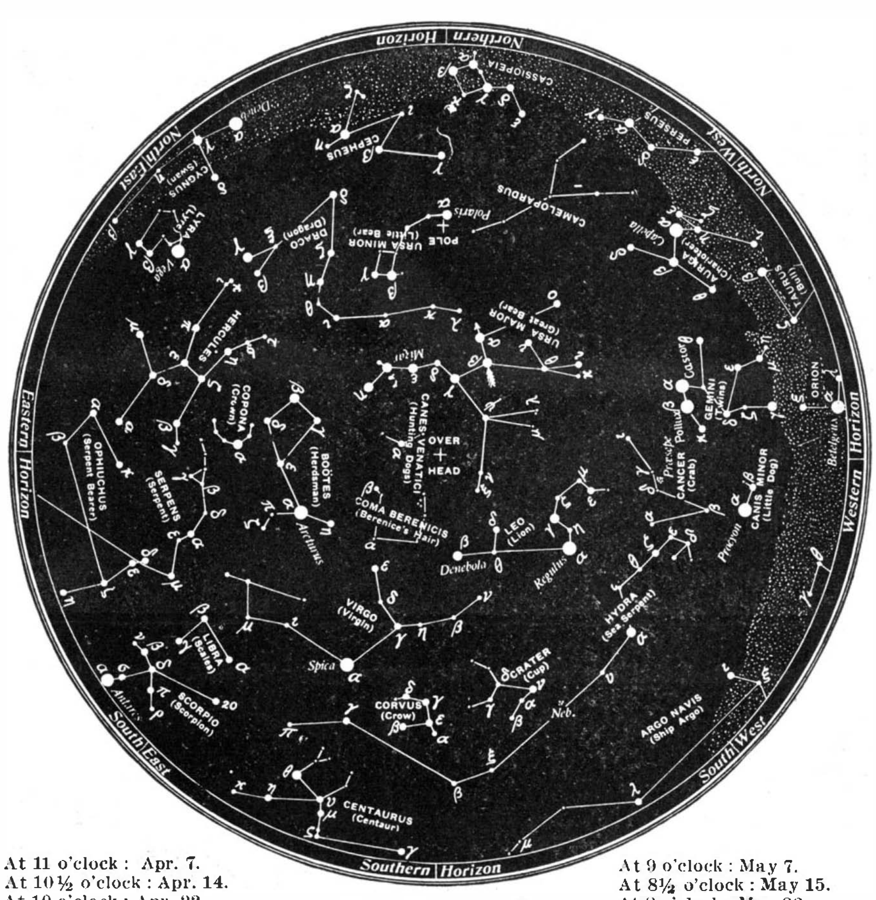
Other observers have confirmed Slipher's results regarding the motion of the Andromeda nebula, and there remains no doubt that these great luminous clouds are in motion far more rapidly than any other known bodies.

Still more recently, Prof. Campbell has summarized the results of similar observations made at the Lick Observatory on a number of gaseous nebulæ, mostly of the small and sharply defined sort which from their appearance are called "planetary." These are also in rapid motion, their velocities in the line of sight averaging nearly 50 kilometers per second, which is three times the average for the stars, though far less than for the spiral nebulæ.

We are now in a position, if not to determine the average distances of these nebulæ, at least to extend our estimate of their minimum average distance to a very marked degree. There is not one nebula in the sky whose apparent proper motion in the heavens is as rapid as one tenth of a second of arc per year, though one out of four of the stars visible to the naked eye exceeds this limit. Indeed, the apparent motions of the nebulæ are so slow, and they are usually such ill-defined objects to set upon, that it is usually impossible to say whether they are moving at all. Recent studies, both photographic and visual, make it clear that the average apparent motion of these objects cannot be greater than one twentieth of a second of arc annually, and is probably much less. But the actual velocities of the nebular motions which appear to us in the sky to be so slow are probably as great as those revealed by the spectroscope; indeed, they should average greater, for it is easy to show that, in the case of a large number of bodies moving at random in all directions, there is a greater chance that the motion will be mainly at right angles to our line of sight than that it will be directed straight toward or from us.

In this way we may estimate that the actual motion of a gaseous planetary nebula in the sky corresponds to an annual shift of fully fifteen times the distance of the Earth from the Sun, and that of a white spiral nebula to no less than 120 of these astronomical units.

Even with the exaggerated estimate of the nebular proper motions made above, this would indicate that the planetary nebulæ were, on the average, at least 1,000 light-years distant, and the spiral nebulæ eight times as remote. But these are minimum limits, and probably much too small. It would seem more accordant with the data available at the moment to say that the average distance of the planetary nebulæ is probably at least two or three thousand light-years, and that of the spiral nebulæ twenty thousand or more; and it seems probable that fuller knowledge is fully as likely to increase as to diminish these figures.




At 11 o'clock : Apr. 7.
At 10½ o'clock : Apr. 14.
At 10 o'clock : Apr. 22.
At 9½ o'clock : April 30.
At 9 o'clock : May 7.
At 8¼ o'clock : May 15.
At 8 o'clock : May 22.

NIGHT SKY: APRIL AND MAY

The dimensions which the nebulæ must have, to appear as big as they do at such distances, are astounding. Even the planetary nebulæ, at the smallest estimate of their distances, must be hundreds of times the diameter of our whole solar system, and the size of the spirals can only be measurable in light-years, perhaps in tens or even hundreds of them.

This disposes altogether of the idea that they can be masses of cosmic fog, lit up by single stars, and leaves us shut up to the belief that they are star-clusters.

A further support to this theory is afforded by the latest observations of all, announced but a few days ago.

The Magellanic Clouds, those curious outlying patches of light in the southern heavens to which we referred last month, contain, in addition to innumerable faint stars, many nebulæ, which from their positions and grouping seem almost certainly to be themselves a part of the clouds. Prof. Wilson, measuring the radial velocities of these nebulæ from Lick Observatory photographs, finds that four of them, in the larger of the two clouds, have very large and nearly equal velocities of recession, averaging 275 kilometers per second—far greater than that of any other gaseous nebulæ so far observed—while one in the smaller cloud is also receding, but at 160 kilometers a second.

This suggests very strongly that these great clouds of stars and nebulæ are themselves in motion at these velocities. If observations of the individual stars in the clouds prove practicable and show that they are moving at a similar rate, there will be very good reason for thinking that the white nebulæ, which show just the same spectrum which the star-clouds would exhibit, and are moving with comparable velocities, are really of the same nature, but too far off to be "resolved" telescopically. This brings us back to the old conception, held two generations ago, but almost abandoned, that the nebulæ are other "universes" of stars like our own.

Hutzsprung's estimate that the smaller Magellanic Cloud is 30,000 light-years distant gives us some idea how far away this hypothesis would put the irresolvable spirals. It is doubtful whether light itself could traverse such stupendous distances without serious losses; but there is no demonstrative evidence that such is the case, and it well may be that we are on the brink of an expansion of our conception of the extent of the universe almost comparable to that which resulted from the first measurements of the distances of the nearer stars.

### The Heavens.

If one holds the accompanying map right over his head, he will see the heavens as they would appear to a man lying on his back and looking upward. The Great Bear is nearly overhead, extending to the northward. The curving line of its tail, the handle of the "Dipper," points toward Arcturus, the principal star of Boötes, and the brightest now visible.

Below, and farther to the west, is the white star Spica, in Virgo; and in the southwest is Regulus, in Leo. The twin stars Castor and Pollux, in Gemini, are conspicuous in the west, with Procyon on the left and Capella on the right, well down in the northwest. The bright object, not shown on the map, below Castor and Pollux, is the planet Saturn.

Below the pole we see the zigzag line of Cassiopeia, and in the northeast, still near the horizon, is the great white star Vega.

With these as sky-marks, it will take only a few moments' study for even the novice to complete his acquaintance with the visible constellations.

### The Planets.

Mercury is a morning star all through April, but is on the far side of the Sun, and gets more and more nearly in line behind him, so that he is hard to see, even at the beginning of the month, when he rises about 5 A. M., and is invisible by the 15th.

Venus is also a morning star, in Aquarius and Pisces, rising at 4:20 A. M. on the 1st, and 3:50 on the 30th, as she comes farther north during the month. She seems still about six times as bright as Sirius, though she has lost fully half her light since the first of January.

On the morning of the 15th she passes very close to Jupiter, the nearest approach, which occurs after sunrise in the United States, being within 9 minutes of arc. These two planets, the brightest in the sky, will, however, appear on this morning to be distant from one another by less than the Moon's diameter, and the sight will be well worth rising to look at.

Mars is a morning star, too, near the others in the sky, and rises at 4:20 A. M. on the 15th. On the 3rd he is in conjunction with Mercury, being 1½ degrees north of him. Mercury will appear five or six times brighter than Mars, but the sky will be so bright by the time they have fairly risen that it will be hard to see them at all.

Jupiter again is a morning star, rising about 4 A. M., and fairly well observable before daybreak.

Saturn is evening star, between Taurus and Gemini, and remains in sight till 11:30 P. M. in the middle of the month.

Uranus is in Capricornus and rises between 2 and 3 A. M. Neptune is in the very opposite quarter of the sky, in Gemini, and is in quadrature with the Sun on the 18th, when he crosses the meridian at 6 P. M., but on account of his high northern declination, does not set till after 1 A. M.

The Moon is in her last quarter at 3 P. M. on the 6th, new at 7 A. M. on the 14th, in her last quarter at 11 A. M. on the 22nd, and full at 9 A. M. on the 29th. She is nearest us on the 1st and 30th, and farthest

(Concluded on page 325.)

## Legal Notes

**"Means" and "Mechanism."**—The U. S. Circuit Court of Appeals for the Sixth Circuit in Davis Sewing Machine Company v. New Departure Manufacturing Company, has held that a claim of a patent is not functional and invalid merely because one of its specified elements is "means" or "mechanism," this depending upon whether such term is used with reference to the element or sub-combination which is the real point and gist of the invention, or to elements or parts already known and designed to co-operate with the new element in order to complete the claim.

**An Application for Patent Cannot be Enjoined.**—In a recent case in which it was sought to enjoin the filing of an application for patent, Chief Justice Shepherd of the District of Columbia Court of Appeals in affirming the decision of the District Supreme Court decided that the court had no jurisdiction in such cases as the Patent Office procedure is sufficient to determine the real inventorship, with the usual appeals on such question.

**Supreme Court Decisions as to Profits.**—The Supreme Court of the United States decided by Mr. Justice Van Devanter in Dowagiac Manufacturing Company v. Minnesota Moline Plow Company et al., Dowagiac Manufacturing Company v. Smith and Zimmer, has held that where a patent is infringed by the sale of machines which include improvements covered by the patent and the value of the machines is attributable in part to the patented features and in part to unpatented features, the profits arising from the infringing sales belong to the owner of the patent in so far as they are attributable to the patented improvements, and belong to the seller in so far as they are due to the other parts or features.

**A Complex Interference Case.**—In the Court of Appeals of the District of Columbia, Justice Van Orsdel in Wilson v. Harris v. Ellis in a paint removing case involved in interference held that where the application discloses two compositions, one containing wax but not benzol and the other benzol but not wax, such application does not disclose the use of both benzol and wax in the same composition, and while it was argued that to add benzol or wax did not constitute invention, such question was not before the court.

## Trade-mark Notes

**Trade-mark Similarity.**—In Underwood Typewriter Company v. The Universal Stenotype Company, the Commissioner of Patents in reversing the decision of the Examiner of Interferences which sustained a demurrer by the Stenotype Company to the oppositi n of he Underwood Company, held that the U. and T. in the Stenotype Company's mark res mbled the form of such letters as us d in the Underwood Company's monogram mark T. U. S. and that the difference does not sufficiently distinguish the marks to avoid confusion. A number of cases are cited in the decision including the Summit City Soap Works v. the Standard Soap Company, in which the Court of Appeals for the District of Columbia said:

> "This court has adopted a strict rule in refusing registration in all cases where the apparent similarity would probably lead to confusion in trade, holding that the field of selection for marks is so broad that no necessity exists for the invasion of one trader upon even the apparent rights of another and that the broadest protection will be afforded the purchasing, consuming public by the courts."

**Trade-Mark Registrations in South America.**—The importance of trade-mark registration in South American countries has been repeatedly emphasized in these columns. It has never before had the importance it has to-day. Director Barrett of the Pan-American Union is reported as asserting that South America is a purchaser annually of nearly $700,000,000 worth of manufactured products from Europe. He urges that American manufacturers and financiers make an effort at this time to meet the demand, predicting that a magnanimous treatment of the South American countries in the predicament resulting from the European wars and cutting off of supplies from such quarter should operate to our trade advantage throughout the future.

## Notes for Inventors

**Why Not Button It On?**—A woman makes this suggestion. She asks: Why cannot the shoe covers or "spats" be secured to the low shoes on which they are commonly used by snap buttons like glove fasteners? The problem will be so to locate the buttons as to exclude them from view when the shoes are used without the "spats" and also to secure such arrangement as will not be uncomfortable to the wearer.

**No Safety Now.**—Safety razor blades will never be safe now that the women folks can use them for ripping. A patent, No. 1,129,681, has been issued to Guy L. Huyett of Minneapolis, Kansas, for a ripping device in which a safety razor blade is held in a flanged holder so formed as to protect the cutting edges except at one side of one end which is exposed for use in ripping.

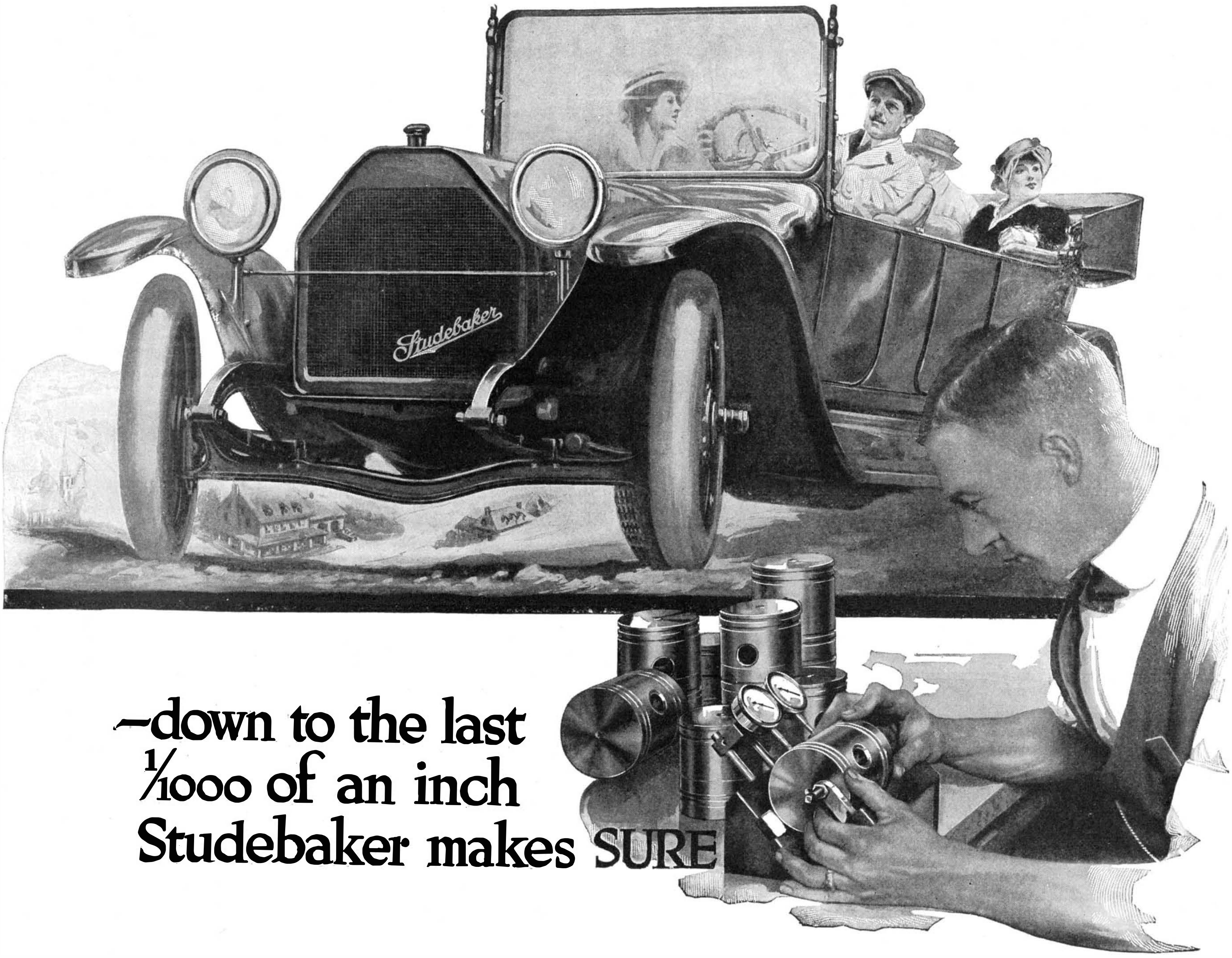
**Roughening the Tongue Side of Dental Plate.**—George A. Critcherson, of Los Angeles, Cal., claiming that dental plates molded with a smooth lingual side result in imperfect articulation of speech and imperfect management of food in mastication, has in patents Nos. 1,129,335 and 1,129,336 provided a dental plate and mold therefor by which the plate is formed on the side next to the tongue in the similitude of the natural human mouth in order to overcome the objections referred to above.

**This Dairyman Collects His "Empties."**—The failure of consumers to return empty milk bottles is a frequent cause of complaint by the milkman and is a source of expense which the consumer must ultimately pay. D. H. Buckley, of Vienna, Ohio, in a patent, No. 1,129,068, has sought to overcome this by a bottle locker operated without special keys which consume time in manipulation, and in which it is impossible to remove a filled bottle without first placing an empty one in the proper compartment of the device, thereby operating as a check upon bottles to be returned and forcing the customer to put an empty in the locker before the bottle of milk can be removed for use.

**Damage by Metallurgical Smoke.**—Suits have originated in many States, including Utah, Tennessee, Montana, and California because of damages claimed to have resulted from the fumes from smelters commonly referred to as smelter-smoke. Various processes of overcoming or decreasing the evil have been devised, including absorption in water, refrigeration, the use of finely ground slag or slag wool, dilution of the sulphur dioxide by air, as well as bringing the gases containing sulphur dioxide into intimate contact with lime in the presence of water. Considerable friction is still caused by smelter-smoke between the metallurgical and agricultural industries in certain parts of the country, which indicates the opportunity of high-class technical invention directed to the subject. A few years ago a committee consisting of Dr. Holmes, director of the Federal Bureau of Mines, E. C. Franklin of Stanford University and Ralph A. Gould, a chemical engineer of San Francisco, was appointed to investigate and decide future questions of annoyance and nuisance resulting from the escape of smelter-fumes and its report, submitted November, 1914, is to be published as soon as practicable.

**The Death of Ross S. Turner.**—Ross S. Turner the well-known artist and art instructor of Boston, died recently in the Bahama Islands. Early in his career he was a draftsman in the United States Patent Office at Washington.

**Why Not a Collapsible Cigar Case?**—It may not be new, but the writer has never seen it in use or for sale; that is to say, a compartment cigar case to put in the pocket whose unfilled compartment or compartments may be collapsed without impairing the protection offered to the cigar or cigars contained in the filled compartment. Possibly some inventor can produce such a case.



## The Decision in the United Shoe Machinery Case

THE decision of the Court in the United Shoe Machinery case, in an opinion written by Judge Putnam, than whom there is no better patent lawyer on the Federal Bench, holds that the company under its patents had the right to impose such conditions as it deemed advisable in disposing of its patented machinery.

In this, the Court is undoubtedly sound. As everyone knows, a patent is a monopoly. While it confers no right of manufacture, use and sale on the owner, it does confer the right *to exclude every other person from manufacturing, using, and selling the thing patented.* In other words, the owner of a patent can say to everyone: You cannot manufacture, use, or sell my patented invention under any circumstances whatsoever. Such a position is legally sound and so long as the contract between the patentee or the owner of the patent and the people is in existence, this attitude may be maintained. The people have promised through their Government agents, that in consideration of their having the free use of the invention *at the expiration of the patent,* during the life of the patent the patentee may have the absolute control as to who may use, and under what conditions the patented invention will be permitted to be used; or, as before pointed out, during that period the use of the invention may be entirely withheld from the public, under any and all conditions.

It must be remembered that the United Shoe Machinery Company does not sell its principal machines but leases them, and the Supreme Court of the United States in the Dick case has unequivocally affirmed the right of the owner of a patent to dictate the terms upon which it is willing to permit others to use the invention of that patent. In the Dick case, the particular machine was a mimeographing or duplicating machine, and the owner of the patent for that machine made it a condition of a license to use, that its licensees should not use with that machine any materials, paper, ink, etc., which were not obtained from the owner of the patent. This the Supreme Court held was its right under the patent.

We cannot see how this right of control of the manner and condition of use of patented property differs in the slightest degree from the right of control of the manner and conditions of use of unpatented property.

Let us assume that one owns a house which because of its locality and particular construction and other advantages someone desires to lease, and believes that he must be permitted to lease that house and that no other house will suit him. Naturally the owner of the house can say to him: No, you cannot have the house at all. No one will question this right in the owner of a house.

However, let us suppose that the owner of the house is a coal dealer, and that he says to the person desiring to lease it, I will lease you my house, but only on one condition, and that is that you purchase all the coal which you need for heating the house from me. There is nothing unfair in that condition; the transaction is perfectly legal, and so far as we can see, there is no difference whatever in that case over the case of the United Shoe Machinery Company in leasing patented machinery.

There is one difference, of course, and that is that in the one case, the title to the property, namely, the house, remains in the owner forever or until he disposes of it by his own act, and therefore he can *forever* maintain the conditions stated; whereas in the case of patented property the rights of the owner terminate at a specific date, after which he can assert no rights of ownership and impose no conditions respecting that particular piece of patented property.

We may expect the usual flood of bills in Congress to change the patent laws, and no doubt they should be changed in some particulars; but we confess we can see no way short of an absolute repeal, whereby the consideration now given a



## INQUIRIES

*Inquiry No. 9431.* Wanted to purchase a mold for shaping and piercing beads made of rose leaf of the consistency of dough.

*Inquiry No. 9429.* Wanted the name and address of a manufacturer of a machine for bleaching beeswax.

*Inquiry No. 9430.* Wanted the name and address of a manufacturer who can supply machinery for producing soluble coffee.

*Inquiry No. 9432.* Wanted the name and address of a manufacturer of watch glasses 9 inches in diameter.

*Inquiry No. 9433.* Wanted the name and address of a manufacturer of a material such as is used by gas mantle makers. The material is used to cover the wire frame that supports the mantle at the top and is used to protect the wire from the flame or heat of the mantle.

*Inquiry No. 9434.* Wanted the name and address of a manufacturer of special pins, 1/16 of an inch in diameter and ¾ of an inch long, the pins to be made of bone.

*Inquiry No. 9435.* Wanted the name and address of a manufacturer who can furnish grinding machines for the hollow grinding and finishing of razors. Up-to-date machines wanted.

*Inquiry No. 9436.* Wanted the name and address of a manufacturer of rat traps having a receptacle attached into which the rat drops and drowns.

*Inquiry No. 9437.* Wanted the name and address of a concern that can make an oil or grease gun. West preferred. Must be able to make in quantities of 10,000.

*Inquiry No. 9438.* Wanted the name and address of a manufacturer of light aluminium sheets, small tubing, rods and wire, also aluminium solder.

*Inquiry No. 9439.* Wanted the name and address of a manufacturer of a knitting machine which was on the market some years ago. The name of the machine was the Bickford Machine. It was a hand knitting machine, weighing about 15 pounds.

*Inquiry No. 9440.* Wanted the name and address of a concern selling Dr. Young's E-Z Sanitary Belt,

patentee, so far as his absolute right of exclusion of all others from the practice of his invention is concerned, can be modified, without materially affecting that promotion of the useful arts and sciences contemplated by our Constitution and upon which is founded that wonderful commercial progress to which our present civilization is indebted.

In other words, if we give a man a patent at all, it can only be a patent which will give him the absolute right to say on what terms others may be permitted to manufacture, use, and sell his invention.

### Detroit's Trade-mark Contest

**"Made in U. S. A." Trade-mark Which Was Awarded $500 Prize by Detroit Board of Commerce Feature of "Made in U. S. A." Exposition**

A NOTABLE feature of the "Made in U. S. A." Industrial Exposition at the Grand Central Palace was the "Made in U. S. A." trade-mark which was awarded the $500 prize offered by the Detroit Board of Commerce. It was chosen from 119,000 submitted by citizens of the United States, and is the joint effort of James Harley Nash, a designer, and of Clowry Chapman, a trade-mark specialist, both of New York.

A condition of the contest was that this design was to become the property of the people of the United States, and not merely of Detroit business men. In appreciation of this broadly patriotic attitude of the Detroit Board of Commerce, the El Paso, Texas, Chamber of Commerce, came to the front with a further prize of $50.

The award of the prize was given a further national appeal by judges having been chosen from other cities. These judges were: James Keeley, editor and publisher of the Chicago *Herald;* Charles Daniel Frey, a well-known designer of Chicago; Edward Freschl, president of the Holeproof Hosiery Company of Milwaukee; Orson D. Munn, patent and trademark lawyer of the firm of Munn & Co., New York; and Charles B. Warren, president of the Board of Commerce of Detroit.

The winning design was submitted in color and in black. It shows an eagle in silhouette on whose outspread wings appear the words "Made in." Below the eagle is the word Detroit, surmounting the letters U. S. A. In the colored design the eagle is blue and the words "Made in" are white, while "Detroit" and "U. S. A." are in red.

In making the award, the judges said: "The design is simple, strong, and mechanically perfect; it can be easily woven in textile fabrics, and is so open that it will reproduce perfectly down to a quarter of an inch; its use as a stencil, stamp or metal die presents no difficulties, and its character is such that it will print satisfactorily in any medium or by any process. The design is elastic in that the name of the city can be omitted or widened, or contracted, without destroying or impairing the composition. The design, also, is thoroughly American in atmosphere, composition, and color scheme. Its merit is simplicity, and legibility will be a strong argument for its adoption and use on American merchandise in foreign trade."

### The Use of Patented Pavements by Cities

MANY laws, city charters and city ordinances have been enacted forbidding the use of patented materials or machines in municipal work, according to the *Engineering News*. These laws have had their origin partly in some notable cases in the past where patented devices have been used at exorbitant cost to the taxpayers as a result of dishonest collusion with city officials, and partly in cases where suits for very heavy damages have been brought against cities because of some use of a patented device without consent of the owner of the patent. Such laws, however, have proved impracticable of complete enforcement. The progress of the arts is largely reflected by the issue of patents, and to wholly prevent a city from using any patented device until the patent had expired, 17 years from the date of its

issue, would place the city hopelessly behind the times.

An interesting review of the status of the laws covering the use of patented paving materials by cities was recently given in a lecture delivered before the highway engineering class of Columbia University, by George C. Warren, president of Warren Brothers Company, Boston, Mass. Mr. Warren is, of course, an interested party, but his wide experience in litigation over the use of patent paving should make his summary authoritative.

Cases involving the legality of the adoption of patented pavement by municipalities have been decided within the past 20 years by the highest courts in the States of New York, New Jersey, Ohio, South Carolina, Oregon, Missouri, Maryland, Louisiana, Kentucky, Michigan, Kansas, Iowa, Indiana, Idaho, Oklahoma, Pennsylvania, Tennessee, Massachusetts, California, Montana, Washington, Wisconsin, and Illinois.

With the exception of the last two States, the final decision in all of the States is to the general effect that, where the owner of the patent voluntarily surrenders his exclusive rights and agrees to allow any contractor to use the patent, on the payment of a reasonable price, all the competition which the law requires is provided. Under such regulations, patented pavements may be laid and contracted for by municipalities; and any State law which prohibits the adoption of a patented pavement by municipalities is unconstitutional, because it attempts to prevent the exercise of the federal patent franchise, which is based on the United States Constitution.

Of the two States in which decisions of the final courts have been adverse to patented pavements, the Wisconsin legislature promptly amended its law so that patented pavements may be used; and Illinois stands alone as the only State in which there is practically a prohibition of the use of patented materials in municipal assessment work.

The courts of most of the States above referred to have declared that the competition required by the State laws is provided if the owner of the patent files with the municipality a binding agreement under which, at a certain price, he will sell the patented portion of the pavement, which patented portion is generally confined to the wearing surface, to any responsible bidder; so that all such bidders may compete with the patentee or his agents for the construction of the whole pavement.

### Inventors and the Piano

When we realize the multitude of inventors who have tried their hand at devising mechanism for the piano it is surprising to note that, although it has undergone many alterations, the check action invented by Erard nearly a hundred years ago is still in use to-day in all its essential features. Most inventors in this line have directed their attention to improvement in the hammer and damper mechanism; but it is reported that recently an important improvement has been made in the key mechanism that is quite revolutionary. The ordinary key works on the fulcrum principle, and it is necessary to counterweight each key with lead, and although the keys work easily there is a very considerable weight of material to be put into motion. The new plan is to delicately balance each key on a rocker, thus producing the "cradle" keyboard. This plan enables the key to respond more readily to the touch, and repeats more rapidly, and as the damper is operated quicker rapidly succeeding notes all come out distinctly, and the ordinary doubling of sounds is overcome. Greater delicacy is claimed with no loss in power.

### A Chance for Inventors

A reader of the Scientific American wants to know where he can get a satisfactory working side suspension for four drawer metal furniture, such as filing cabinets. The principal requisites are easy action and low price of production. Here is an opening all ready and waiting for the right inventor.

## The Heavens in April

(*Concluded from page 318.*)

away on the 17th. She is in conjunction with Uranus on the 8th, Venus on the 10th, Jupiter on the 11th, Mars and Mercury on the 12th, Saturn on the 19th, and Neptune on the 22nd. The conjunction with Venus, which occurs at 10 A. M. on the 10th, will afford a very good opportunity to pick the planet up with the naked eye in the daytime about 2 degrees to the southward of the Moon.

**Mellish's Comet.**

Later elements of this comet indicate that its perihelion passage will occur in the latter part of July, at a distance slightly exceeding that of the Earth. The comet should then be pretty bright, but will be too far south to be well observable in this country. No exact ephemeris of its position is at hand, but it appears that on April 1st it will be in about 18 hours 2 minutes right ascension and a little more than 1 degree south of the celestial equator, and moving slowly eastward and southward. It is already a conspicuous telescopic object.

Princeton University Observatory.

## Freeing Condensed Steam From Oil

CONDENSED steam furnishes water which is in some particulars especially adapted for boiler supply. Since it is, of course, a distillate, it has been freed from the mineral matter which forms the troublesome deposit in boilers known as scale. Furthermore, it retains a considerable degree of heat. But unfortunately such re-use is rendered difficult in spite of these advantages by the fact that the steam in passing through the engine carries with it a certain amount of lubricating oil which subsequently fouls the condensate. When water thus contaminated is used to feed boilers, the oil adheres to the walls and gradually accumulates until it is present in sufficient quantity to retard the passage of heat to such an extent that there arises the danger of its causing superheating of the hot surfaces.

Obviously, therefore, this oil must be extracted from the water before its re-use in boilers. Such extraction is difficult because the oil is present not in drops, but largely in the form of tiny particles so intimately mixed with the water as to form an emulsion. In such form even a long period of rest is not sufficient to separate it entirely; likewise filtration through coke, sponges, cloths, etc., is only partially successful.

Better results are obtained by chemical means. In this process soda and sulphur containing clay are added to the water. This method, however, is open to the objection that it requires elaborate and costly apparatus which demands careful attention, which obviously makes its practical application difficult.

A third method seeks to free the steam from oil before condensation. Various forms of apparatus have been constructed for this purpose, but the condensate always contains some trace of oil, so the trouble is at best deferred. Recently, however, a new process has been advocated, which claims to render the water entirely free from oil without great expense or trouble. This is known as the Halvor-Breda-A.-G. patent process. It is described in a recent number of the *Technische Monatshefte* by Dr. Hanus Günther. According to him, it utilizes the fact that an electric current conducted through water containing oil causes the oil to collect in foamy flakes, which can easily be removed by mechanical means.

The apparatus consists of a large wooden container in which numerous iron plates are placed as electrodes. The oily water coming from the condensers flows slowly past these plates. The electrodes beneath the stream of water draw the tiny particles of oil to them and form a sort of oily slime out of them. When the current is reversed this slime is loosened and rises in flakes to the surface of the water. Here it can be skimmed off completely. If the water, after being thus de-oiled, be passed through a gravel filter, the product is crystal clear and entirely

free from oil and fit to be used for any purpose.

The current required is from 0.15 kilowatt to 0.2 kilowatt per cubic meter of water, according to the amount of oil contained. According to this, the cost of de-oiling when there is a moderate content of oil and at the current price of 7 pfennings per kilowatt, comes to about 1 pfenning.

An advantage is that the apparatus requires no watching. The work of the attendant is confined to reversing the current every few days, skimming the slime off, and washing the filter when necessary. According to the experiments made, these labors consume from ten to fifteen minutes, so that the machine attendant can easily perform them.

## Food Production in the United States

CONSIDERING the high and constantly increasing cost of food, the report of the Commissioner of Agriculture cannot be regarded as in the least reassuring. While he finds that the crop yields per acre for the whole country were 2.3 per cent better during the present year than for the past ten years and the average yield of all the staple crops was 9.4 per cent greater than last year, still there was not only a relative, but an absolute decrease in a number of staple food products, such as corn and meats, the figures being as follows.

In cattle, sheep and hogs there has been an absolute decline—in cattle, from the census year of 1899 to that of 1909, of from 50,000,000 head to 41,000,000; in sheep of from 61,000,000 to 52,000,000; in hogs of from 63,000,000 to 58,000,000. Since 1909 the tendency has been downward, and yet during the period since 1899 the population has increased over 20,000,000. This situation exists not in a crowded country, but in one which is still in a measure being pioneered, in one which, with 935,000,000 acres of arable land, has only 400,000,000, or 45 per cent, under cultivation, and in one in which the population per square mile does not exceed 31 and ranges from 0.7 person in Nevada to 508 in Rhode Island.

Discussing this situation the Commissioner remarks: "Just what the trouble is no one is as yet sufficiently informed to say. It can scarcely be that the American farmer has not as much intelligence as the farmer of other nations. It is true that the American farmer does not produce as much per acre as the farmer in a number of civilized nations, but production per acre is not the American standard. The standard is the amount of produce for each person engaged in agriculture, and by this test the American farmer appears to be from two to six times as efficient as most of his competitors."

Coming from one in his position, this statement is rather surprising and the argument altogether fallacious, as it is very evident that what the present-day farmer takes out of the soil by superficial methods of tillage and treatment his successors will have to pay back with heavy interest in the way of additional labor; but he admits that the future aim must be, "while maintaining supremacy in production for each person, to establish supremacy in production for each acre."

## Random Reflections

**By Irresponsible**

SOMEBODY once said that patriotism was a sentiment felt only by fools. There is a certain broad point of view from which this remark looks true, but the view is a little too broad for accuracy; just as a glass which gives a broad field of vision does not usually give extreme sharpness of definition. Broad-mindedness can be pushed to extremes: the transition is not great from regarding all views with equal interest to regarding all views with equal indifference. This point is made by Mr. Chesterton in his pertinent query: what is more broad-minded than a turnip? But without being broad-minded to the verge of impotence I have a qualified sympathy with that remark

about patriotism: I think that misplaced patriotism is a nuisance, but I also think there is a sense in which patriotism is very necessary. It is a human thing and so, of course, it has its drawbacks: it is also something for which millions of human beings have died, and so there is probably a good deal in it. To modify a certain celebrated remark, all people have not been fools always.

It seems to me that there are two sides to patriotism as one usually meets it: the patriotism which means love for one's country, and the patriotism which means dislike of other peoples' countries. I think the second kind is a nuisance, and its possessors fools. The fools may, of course, be very able men, great lawyers, merchants, writers, or great scientific men. But have you never met indisputably clever people who impressed you as being fundamentally fools? That is the kind of foolishness I mean. I believe myself that this peculiar and deceptive kind of foolishness is due merely to a lack of a correct sense of proportion, which accounts for the fact that there are really clever politicians who take themselves seriously. Probably we all differ from one another in our sense of proportion, but we feel instinctively that the differences should be kept within certain limits. I may say that music is a greater art than painting, and while you may not agree, I don't suppose you would think it a necessary consequence of that statement that I am a fool. But if I said that ragtime was the greatest musical form yet created, you would, I sincerely hope, consider me a fool. A patriot may, in this limited sense, be a fool.

I, for instance, am an Irishman, and there are certain Irish characteristics which attract me immensely; but I have no desire to force them on the rest of the world. I want to keep them: I shouldn't like to see them die out; but I don't clamor for them to be made universal. I don't want to turn Englishmen into Irishmen. The Englishman as he is, with all his objectionable self-complacency, interests and amuses me enormously. And it is because his desirable qualities are *different* from those of the Irishman, that I want him to go on existing. I should like to emphasize that, because I think it an important argument for the desirability of patriotism.

We should be patriotic, in the sense of insisting on the excellencies of our own countries, because a number of *different* good things is what the world wants. Truth is many-sided, and we want a lot of different points of view. We want to keep in the world the French view of things, the German view, the Russian view, and all the other views. We want distinct nationalities and distinct national characteristics. We want to encourage in the whole world the same diversity that we encourage in any one country. We don't want Joseph Conrad to write like Charles Dickens, and we don't want either of them to write like William Shakespeare. They are valuable not only because they write good stuff, but because they write different stuff. A second-rate man imitating Shakespeare is not producing anything very valuable, but a second-rate man writing something quite different from Shakespeare is probably producing something worth while.

## A Medal for the Inventor of Invar

THE city of Philadelphia, acting on the recommendation of the Franklin Institute, Philadelphia, Pa., has awarded the John Scott Legacy Medal and premium to Charles Edward Guillaume of Sevres, France, for his alloy invar. This alloy contains approximately 63.8 per cent iron and 36.2 per cent nickel, and is characterized by possessing an extremely small coefficient of linear expansion, about 0.0000004 per deg. Cent. Within the limits of atmospheric temperature change, its expansion is very exactly proportional to the temperature. It has a modulus of elasticity of about two thirds that of steel, and its hardness is greater than that of hard brass. Invar has found a wide application in metrology and horology. In the former, it is particularly useful for

secondary standards of length, and in the latter it is employed for pendulum rods, compensating devices for torsion pendulums and balance wheels correcting the secondary error of temperature in chronometers. Dr. Guillaume has done a large amount of research work in connection with iron-nickel alloys, in the course of which he also discovered platinite.

### Producing the Effective Temperature of the Sun

**By Our Berlin Correspondent**

WHILE enormous strides have been made lately in the production of extremely low temperatures, resulting in some most valuable discoveries in the field of science and engineering, high temperature work has been relatively less successful, in spite of the very important results likely to be derived in this connection. In fact, until very recent times, the temperatures of many of our usual sources of light, such as carbon filaments and arc lamp craters, could not be gaged with even a fair degree of approximation.

In an address delivered before the Society of National Culture not long ago, Dr. Otto Lummer, the well-known physicist of Breslau University, drew attention to the fact that the temperature of the positive crater of arc lamps, as determined by himself, viz., about 4,500 deg. Cent., is the highest terrestrial temperature so far realized. Whereas in the case of terrestrial illuminants the actual temperature can be gaged, we must be satisfied with determining the *effective* temperatures of celestial bodies. Supposing the sun to radiate like a "black" body, that is, a body perfectly absorbing any incident radiation of any wave-length whatsoever, its "effective" or "black" temperature can be determined from the sum total of radiation sent to the earth (solar constant), the figure thus found being about 6,000 deg. Cent.

Now, Dr. Lummer, in the course of his recent work, has succeeded not only in reaching, but in considerably exceeding this effective sun temperature. In this connection he was guided by the fact brought out by his previous experiments, that the temperature of the two craters of an arc lamp burning in the open atmosphere cannot be driven beyond a maximum figure (4,500 deg. Cent.), this temperature thus being constant within wide limits of current intensity and arc length.

The constancy of this temperature could be due to the carbon's reaching either its melting or its boiling point. Dr. Lummer having yet then been unable to melt the carbon of arc lamps, and the melting of carbon at ordinary pressures being considered unfeasible, he could not but conclude that the temperature observed was the boiling point. Experiments made to ascertain this, however, brought out the fact that the carbon was actually reduced to a liquid condition, and after separating the liquid from the solid phase and investigating at several degrees of vacuum the solid part of the evaporating crater, a regular drop in the temperature of the crater was observed with decreasing pressures. Dr. Lummer then proceeded to undertake a series of tests at increased pressures, when pure carbon arc lamps were found to form nothing like stationary arcs with large craters corresponding to the current intensity. Special means, of which details cannot yet be published, had therefore to be devised in order to produce a true, stationary arc with crater temperatures corresponding to the increase in pressure. In fact, Dr. Lummer succeeded in ascertaining a regular increase in temperature, with rising pressures, a surface brightness about eighteen times the normal figure being reached at about 20 atmospheres, corresponding with a temperature of about 7,800 deg. Cent.

Temperatures exceeding by about 3,000 deg. Cent. the so far highest terrestrial temperature (4,500 deg. Cent.), were thus for the first time produced in the laboratory. Whether still higher temperatures can be obtained in this way obviously depends on the possibility of producing true arc at even greater pressures.

It is expected that "high pressure" arc

lamps, when manufactured in a commercially suitable form, will play an important part in the art of illumination, allowing, as they do, the radiation of an enormous amount of light from a relatively small surface. It is also hoped that this lamp may prove more economical than any other source of artificial light. Though comprehensive experiments will still have to be made in this connection, there is every reason to suppose that craters heated up to sun temperature will give out a light similar to real sunshine, that is, some sort of "artificial sun light." The possibility of using the new lamp for therapeutical purposes, e. g., for producing greater amounts of ultra-violet rays than have so far been feasible, will likewise be investigated in the further course of these promising experiments.

## World's Largest Soup Kitchen

THE Brussels soup kitchen organized by the London Commission for Relief is now undoubtedly the very largest in the world. Nearly 50,000 people entirely destitute wait in the "bread lines" every day, and over 6,000 gallons of soup and 4,000 kilogrammes of bread are daily distributed to them. Unlike the "bread lines" I have seen in America, these are all people of one nationality, and all with a common and undeserved misfortune. Some are transients, it is true, but the large majority are people of Brussels. As one of the canteen directors said:

"They are of all classes, but we know none of them save by number, because no matter what their station or the extent of their misfortune, they still have *l'amour propre*, and many of them if they were compelled to write their names on coupons when they get the soup would rather starve than take it."

The soup for those pitiful flotsam and jetsam of war is all prepared in the large storehouse of the International Express Company Van Gand. More than 100 people are engaged in this work. Among them are former chefs of some of the leading hotels of Brussels, who give directions as to the kind and quality of the soup, its ingredients, and their proportions. Under them are those who clean the vegetables—potatoes, carrots, beans, etc.—and prepare the meat. This entire staff is composed of volunteers, except the chefs, who receive at the most half a crown a day.

From three o'clock in the morning, when the cooking of the first 5,000 gallons of soup is started, the scene in the circus-like storehouse of the Express Company is one of tremendous activity, with the moving figures of the 100 white-clad chefs, the fires ablaze under scores of immense cauldrons—all dimly seen through the shifting clouds of pungent steam rising from the boiling soup.

When the soup is cooked it is sent, under the seals of the Commission and under the protection of the American flag, in large lorries to the twenty-one canteens, scattered all over Brussels. These canteens were formerly schools, dance halls, Turkish baths, etc. During the morning, wherever one goes, women and children may be seen coming and going with pitchers of steaming soup and their ration of bread under their arms.

While Brussels is being fed, the 100 trained hands at the soup kitchen start preparing vegetables and meat for the next day. It keeps them busy. On December 24 the staff had to prepare for Christmas—which was a normal day so far as this work is concerned, although the director told me rather pathetically that he was trying to make "*une soupe de fete*"—the following: 1,000 pounds of potatoes, 1,800 pounds of meat, 2,400 pounds of celery and carrots, 1,000 pounds of onions, 1,000 pounds of South Carolina rice, and 1,000 pounds of noodles made from American flour.—*The London Daily Telegraph.*

## Caffeine Free Coffee

CAFFEINE, the alkaloid which causes the stimulating effect of coffee and tea upon the heart and nerves, constitutes about half of one per cent of the weight of the coffee bean. In the usual process for producing caffeine-free coffee, the caf-

feine is extracted by volatile solvents, such as alcohol and benzol, after the cellular tissue of the coffee bean has been softened by steaming and the caffeine salts have been decomposed by means of acids or bases. This process is applicable only to raw coffee. Analyses of the product show that at least one sixth part of the ingredients which give coffee its flavor and aroma are removed with the caffeine. Dr. R. Ditmar states, in *Die Umschau*, that L. Klein has patented a new process by which the caffeine can be almost completely extracted with little loss of the flavoring and aromatic ingredients. Raw coffee is mixed and stirred, under pressure, with slaked lime and soda. The stirring is continued while the mass is gradually heated to 200 deg. Cent. (392 deg. Fahr.) and kept at that temperature until the coffee beans begin to swell. The coffee is then transferred to an apparatus in which it is first dried and then heated to about 160 deg. Cent. (320 deg. Fahr.), so that it is partially roasted.

### Engineering Openings in Russia

THE British Consul-General at Moscow has forwarded a report received from a reliable source in regard to the machinery import trade of Russia, which contains a list of various classes of machinery which have hitherto been imported from various Continental countries, but which it is considered might now be replaced by British manufactures. It is stated that about fifteen years ago German machinery makers sent to Russia representatives who noted what had been supplied by English firms, copied some of the advantages, and proceeded to remedy defects which were pointed out by users, with the result that in a short time machinery was delivered from Germany which met users' requirements, and was delivered at Moscow at lower prices than English machines. All classes of machinery entering Russia have to pay duty by weight, and while English makers, with few exceptions, have practically ignored the rôle that weight plays when duty is imposed upon it, the Germans have attached importance to it. In many machines there are heavy, rough cast-iron and other parts which could be made in Russia at a price which would considerably reduce the total cost of the machine to the purchaser delivered at his mill or works. This is a phase in the machinery trade worthy of consideration by English producers of heavy, rough machinery who are desirous of entering the Russian market. With the development of municipal institutions in Russia it is asserted that there is a great field for contractors capable of installing water works, gas works, electric light and tramway plant, etc., but recently German firms have invariably obtained such contracts. One of the causes contributing to their success in this direction has been the ready way in which the German business houses have met purchasers in regard to terms of payment, etc.; this has been possible owing to the fact that the interests of various German makers have been so interwoven that they could obtain financial support where an isolated English supplier would fail. Moreover, whenever a big scheme has been under consideration, the German combines have had their representatives continually in touch with those who have had the placing of the orders, and by constantly assisting them, free of charge, to draw up specifications, these representatives have succeeded in getting specified just those classes, designs, models, and sizes which could only be obtained from German firms. British machinery manufacturers, who wish to obtain a share of the Russian orders hitherto placed in Germany, are urged to commence the necessary propaganda at once, and not to wait until the war has terminated. They should prepare their circulars in the Russian language, and cause them to be distributed to likely customers through reliable agents. The distribution of circulars in a haphazard way will do little good; they should be sent out by firms or individuals on the spot who know exactly who are the users of the machines described.—*Engineering*, London.

## The Zeppelin Raid on Paris

By C. Dienstbach

FOR the first time the reason of a Zeppelin attack is known with certainty. It was officially announced that the recent aerial night raid on Paris was made in retaliation for what is claimed to have been an unjustified attack on the non-military city of Schlettstadt by a French aeroplane. Hitherto Zeppelin raids seemed to have no very clear object in view beyond more or less indiscriminate bomb-dropping, if the published accounts may at all be trusted.

If these attacks were really aimed, as many believe, at private property and non-combatants, they would be far more senseless and inefficient than we have a right to expect of the highly efficient German army and its General Staff. The obvious difficulty of aiming dropped missiles from a mammoth aircraft, intent on dodging hostile fire, would play no part, as the target offered even by a small town would be immense, and about half of this area would be roofs. But to drop a few heavy, shattering high-explosive bombs on a town would be literally beside the mark. One half of them should more or less harmlessly drop into streets or yards; the remaining two or three might be expected to smash two or three houses. What does the destruction of two or three houses amount to compared with the devastation demanded in the legitimate bombardment of a village used as a stronghold? If a Zeppelin intended anything like making a businesslike job of a savage attack on civilians it would surely drop at least one hundred twenty-pound bombs, suspended under its length, at the rate of three a second, by electrical release, possibly the melinite shells fired from howitzers. (Each Zeppelin carries a fair-sized dynamo for searchlight and wireless.) Some fifty of the bombs would be most likely to hit houses, but it is hardly the nature of an air attack to copy the plan of a bombardment on land. To turn aerial carrying capacity, limited even with a Zeppelin, into smashing force seems wasteful. The air fighter, on the contrary, depends on starting an avalanche rolling—on furnishing only the salient point, or rather an endless multitude of such points, for spontaneous destruction.

The process is like an epidemic starting from a thousand germs, partly perishing, partly resisted. This banishes high explosives, which scatter too much for efficient ignition. Ancient Greek fire, which, unlike gasoline, could not be extinguished by sand, let alone water, and merrily blazed away on the waves, is the weapon for aircraft. But what folly to drop seven or eight rather inferior modern incendiary bombs, as stated of the recent Zeppelin raid, which started a few fires. The Zeppelin becomes a mechanical Attila, the true scourge of God, the moment it scatters over a town (on the windward side) one thousand two-pound torches made of an adequate modern imitation of unextinguishable Greek fire; in other words, an extremely slow, hot-burning explosive. The technical problem of lighting a slow match safely by electric contact in most rapid succession inside each torch as it drops is easily solved. The steel shell of a torch or "fire arrow" must also be strong enough to allow of its piercing roofs after dropping from a great elevation. If these missiles lodge invisibly at night (burning at first only inside) they are all the more irresistible. Now, such a Zeppelin attack would not be more savage than those first mentioned; but, directed mostly against property only, so much less so that it might under certain conditions be intentionally resorted to, it is quite conceivable that Germany would answer the actual starving to death of her women and children, if that were possible, by a modern repetition of the great fire of London. The "attack on London," as it is popularly fancied at present, would engender worse than useless hate.

But a modern "London conflagration," hopelessly beyond control from the outset, perfectly feasible because Zeppelins found their way irresistibly and unfailingly to other darkened British cities in night and fog, offers a different outlook—an outlook which tends to strongly prove the advisability of keeping religiously, even in this horrible war, to the wisely established rulings of international law, whether they affect blockades or bomb-dropping.

In the light of such considerations, "Zeppelin raids" to date appear rather as what they probably were—casual and cautious first trials of actual war conditions for moral effect without intent of true fighting; or, in the most recent case, an intentionally limited and chiefly moral punishing action. Dropping missiles for "legitimate" military tasks, on the other hand, seems already largely discredited as too erratic in the face of defending artillery.

## Our Neglected Aquatic Foods

ASIDE from its well-known activity in conserving the resources of the country in food fishes and other aquatic animals belonging to our habitual dietary, the United States Bureau of Fisheries has long been conducting inquiries into the potential value and possibility of using various aquatic products which are wholly neglected or but inadequately utilized in this country. An example is the sea mussel, a cheap, abundant, and excellent food, but one rarely seen on American tables. The bureau issued several reports calling attention to this food, but without accomplishing the desired result. Finally, early in 1914, a more energetic campaign was inaugurated in Boston, where one of the leading hotels was induced to add the sea mussel to its bill-of-fare. At the same time the matter was given publicity in the newspapers, with the result that in a few months mussels were being served and given a conspicuous place on the menus of over seventy of the principal hotels, restaurants, and clubs of the city. Having thus become familiar to the public, mussels were placed on sale by retail dealers and vendors, who were furnished with large placards giving the product the endorsement of the bureau, and wide distribution was made of a circular explaining the merits of mussels, and giving a number of recipes for cooking them. Finally, the members of the police force were supplied with mussels and circulars, in order that the policemen's homes in all parts of the city might serve as foci of information on the subject. This propaganda is to be extended to other parts of the seaboard. As the mussel is suitable for canning, its use will probably spread to all parts of the country. Preliminary steps have been taken toward a similar campaign in behalf of the dogfish. At present this fish is not only not utilized to any extent for food, but is a serious scourge to the established fisheries on account of its rapacious habits.

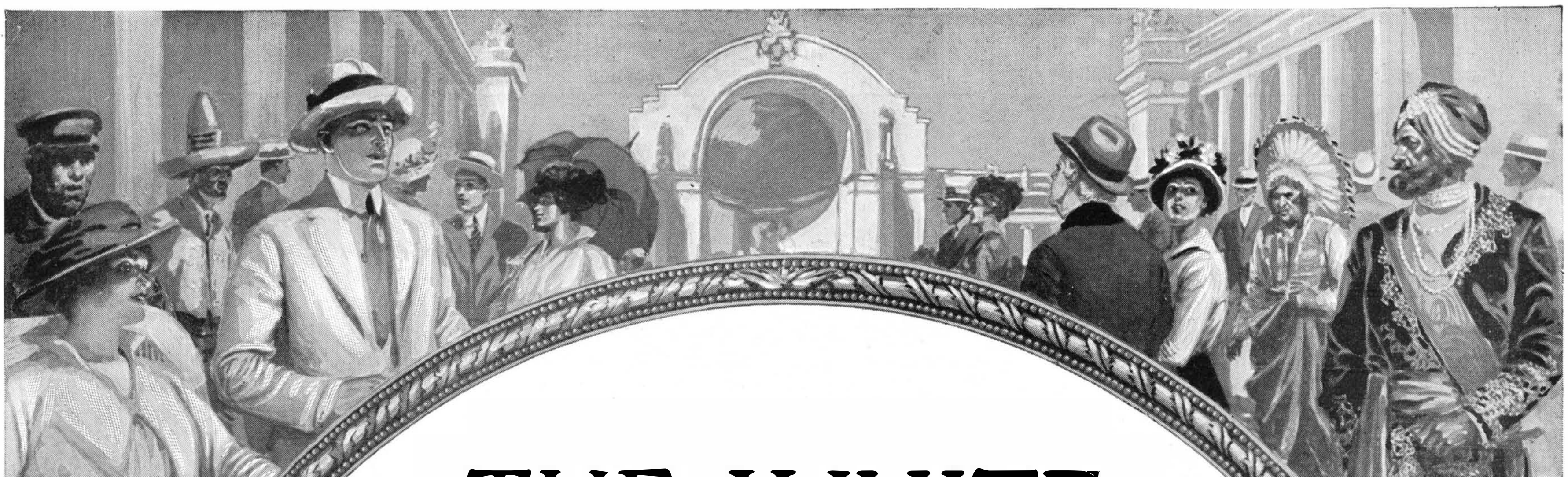
## Hypnotism

HYPNOTISM is associated in the minds of many persons with the vaudeville stage; they think of it as a sort of psychological charlatanry in which the performer, sometimes through the assistance of confederates in the audience, who volunteer as subjects, amuses, but deceives, the spectator.

"The truth of the matter is," holds Prof. P. H. Fogel of the Department of Philosophy of Princeton University, "that the conscious processes underlying hypnotic phenomena, namely, attention and suggestion, are among the most fundamental in human life.

"College courses in the psychology of hypnotism, and similar phenomena are largely confined to the greater universities, for in the small college, psychology is frequently used merely as an introduction to the philosophical consideration of the conventional problems of knowledge and reality, and the teaching staff is usually not large enough to take up all the phases of a psychology of life.

"The literature on hypnotism is voluminous, and the phenomena themselves are of interest and importance, on account of their relation to medicine, education, law and morals."



# THE WHITE

*—in itself an exposition of progress*

That The White is enthusiastically pronounced the final word in motor car designing and construction is not an occasion for wonder when the car is seen.

Sheer beauty of the finally-perfect streamline body harmonizes with the mechanical superiority which has always marked The White.

Possibly no one detail in a motor car has ever evoked such commendatory comment as the absorbing of the conventional back of the front seat in the center cowl—a ripple in the streamline.

This, however, is simply one of many things which blend into the complete charm of the car.

## *White leadership is a principle*

The accomplishment of the final aim in body designing is the outgrowth of that leadership which, among other things, first introduced the mono-bloc, long-stroke, high speed motor; the logical left-side drive; the first perfected electrical system combined with the tremendous advantage of a non-stallable engine.

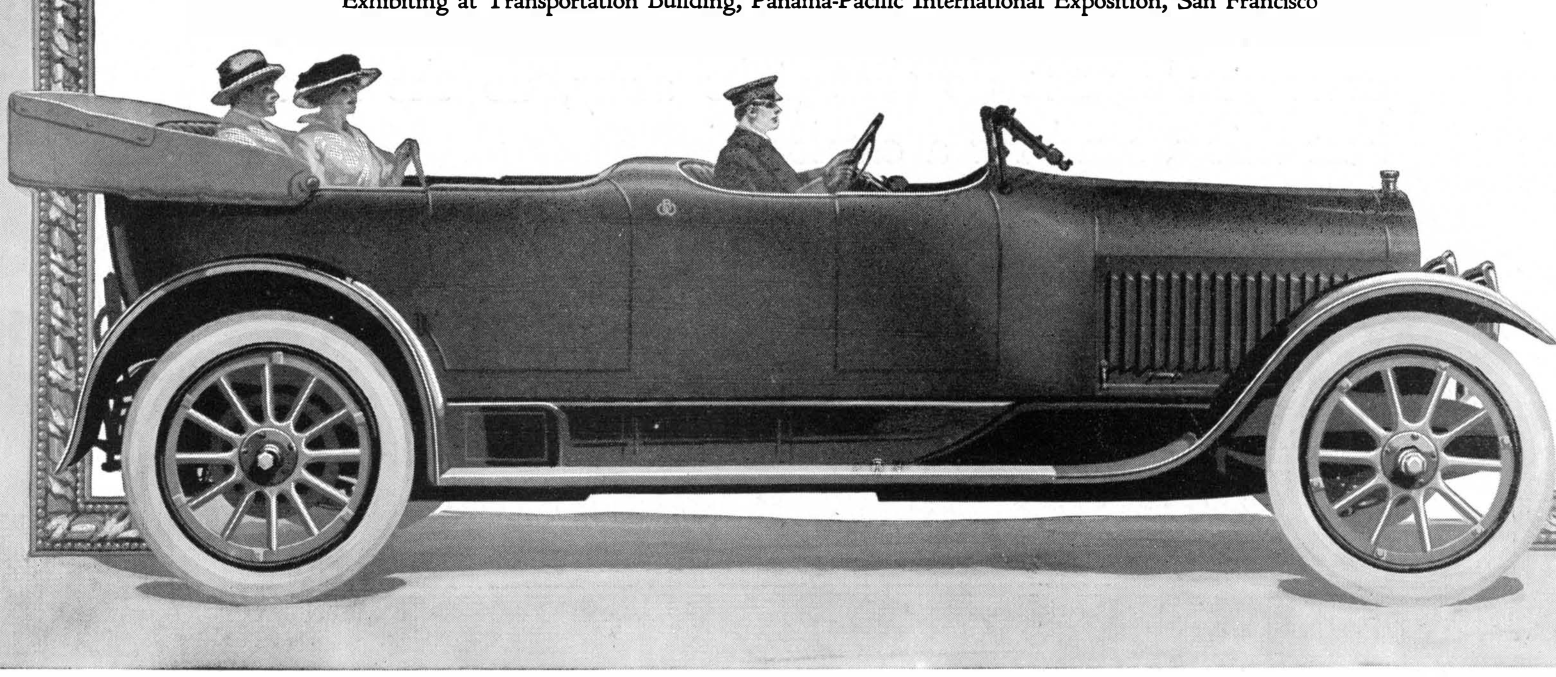
These fundamental mechanical improvements have been basic principles in The White for years.

WHITE DEALERS EVERYWHERE ARE EXHIBITING AND DEMONSTRATING THE DIFFERENT MODELS

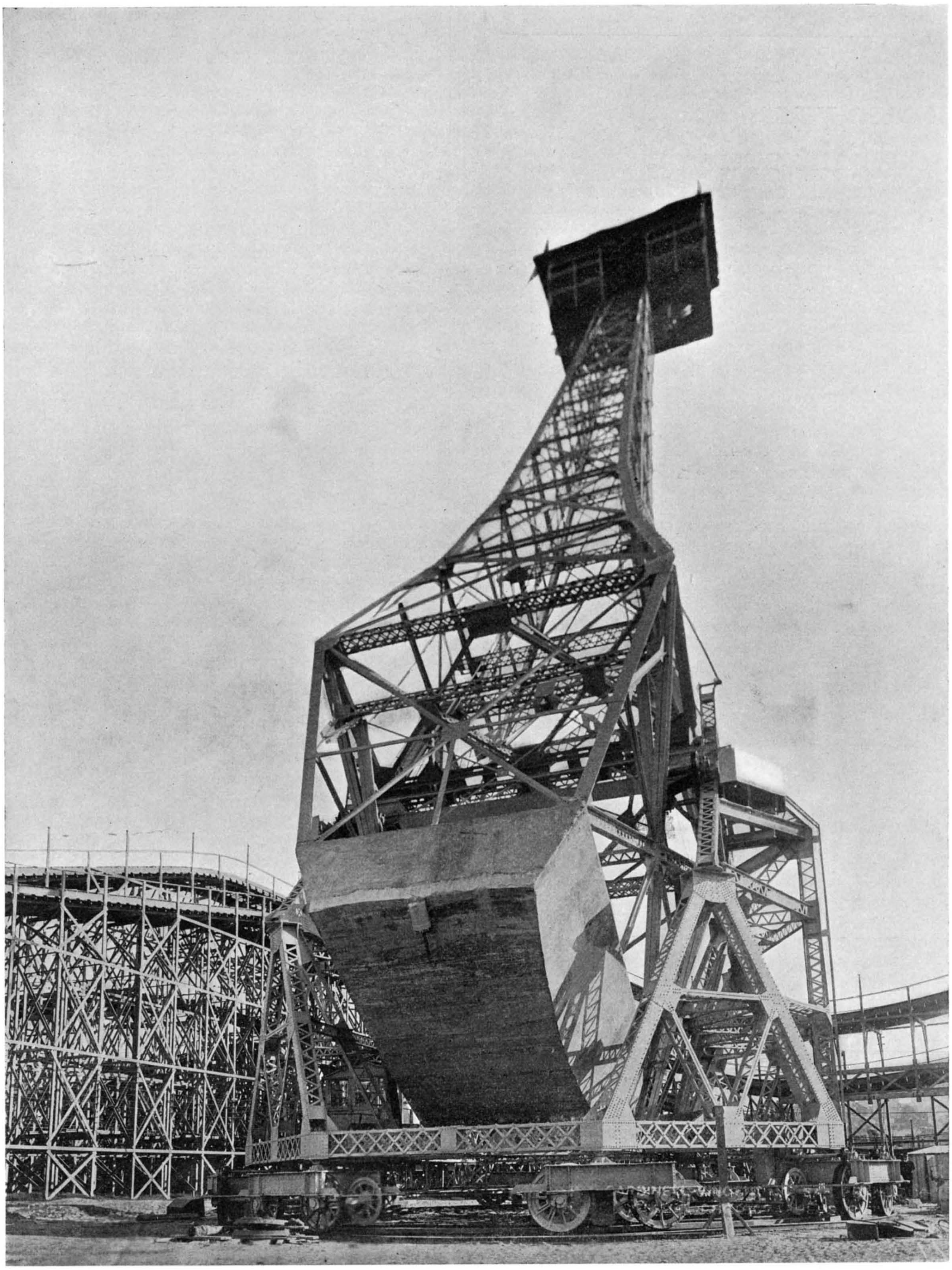
THE WHITE COMPANY, Cleveland

Manufacturers of Gasoline Motor Cars, Motor Trucks and Taxicabs

Exhibiting at Transportation Building, Panama-Pacific International Exposition, San Francisco



SCIENTIFIC AMERICAN



THE AEROSCOPE AT THE PANAMA-PACIFIC EXPOSITION.—[See page 344.]

Vol. CXII. No. 15
April 10, 1915

Munn & Co., Inc., Publishers
New York, N. Y.

Price 10 Cents
$3.00 A Year

SEVENTY-FIRST YEAR

SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

VOLUME CXII.
NUMBER 15.

NEW YORK, APRIL 10, 1915

10 CENTS A COPY
$3.00 A YEAR

**Experiments to discover the effect of radio-active ores on plant life.**

## Radio-Active Ores and Plant Life

**By Harold Bastin**

A SERIES of experiments, designed to show the effects of radio-active materials on plant life, has been conducted by Mr. Martin H. F. Sutton, a member of a well-known firm of English seedsmen. Mr. Sutton's interest in the question was stimulated by the following story. A certain artisan had a heap of soil on his premises and, finding it an obstruction, distributed it over a small patch of garden land, the soil of which had previously been remarkably poor and unproductive. It so happened that the material composing the heap had originally come from one of the "dumps," or refuse mounds, at the French Radium Mine, near Truro, in Cornwall, England. Its application to the garden land led, so it is alleged, to a remarkable improvement in the crops which were grown there during the following summer.

With the object of securing definite information bearing upon this subject, and in the interest of scientific research, Mr. Sutton procured several hundredweight of ore containing radium, as well as certain residues, and with this material carried out an elaborate series of trials with peas, radishes, lettuces, tomatoes, nasturtiums, rapes, clovers, and various flowering annuals, the whole series of experiments comprising some six hundred pots and boxes. In the case of each subject, the dates of sowing, planting and watering, as well as the number of plants treated, were identical; while, except in the case of the rapes and clovers, the trials were conducted in the open without special precautions. The proportion of ore or residue mixed with the soil varied from 1 part in 12 to 1 part in 2,240; and in every experiment the ore or residue was in one box or pot well mixed with the soil, and in another box placed in a layer beneath the soil. The results of every experiment were also compared with "control" batches of plants grown in plain soil only, also with other batches grown in soils with which manures and fertilizers of various kinds had been mixed.

The results of these experiments have been far less uniform than one might have felt inclined to predict, that is to say, some kinds of plants appear to benefit greatly from the presence of radium or allied substances in the soil, while other kinds are scarcely affected. In the case of lettuces, for example, the tabulated results show that seven out of the ten boxes containing radio-active material gave heavier results than the "control" box, but none was so heavy as the product of the box dressed with a complete fertilizer. This, as Mr. Sutton remarks, seems to show that the radio-active ores increased the weight of the lettuces, though not so effectively as the fertilizer referred to. On the other hand, the response of radishes to radio-treatment was very marked. All the boxes containing radio-active materials gave greater weights than the "control" box, while six of them were heavier than those dressed with manures and fertilizers. Scarcely any difference can be seen in peas grown under radio-active conditions, while the same remark applies to carnations.

The experiments conducted with rape and red clover were designed to show the effect of radio-active substances on germination. The boxes of rape received no artificial heat, but those containing the clovers were placed in a greenhouse of moderate temperature. In all other respects the conditions were identical. The results were extremely interesting. The seeds were sown on July 20th. With one exception, which was a trifle later than the others, all the rape seed sown in soil dressed with ore or residue germinated first and equally. On July 27th the "residue" boxes held first place, being followed by "ore," "control," "Clay's fertilizer," "farm yard manure," and "guano" in the order given. In the case of red clover, sown on the same date, all the lots germinated evenly and together, with the exception of "Clay's fertilizer" and "guano," which were a little delayed. As with the rape, however, all the lots of red clover dressed with "residue" were distinctly strongest on July 27th, the positions occupied by the other lots being also approximately the same, with "guano" last.

So far as these experiments have been carried, they seem to show that whereas radio-active materials benefit, in greater or less degree, rapes, clovers, radishes, and lettuces, they have little or no effect upon peas, tomatoes, nasturtiums and other flowering annuals. Soil treated with black oxide of uranium in the proportion of 1 part in 2,240 appeared generally to make the plants more sturdy; but in these cases it was noticeable that the inflorescence was retarded.

## Belgian Bridge in Reinforced Concrete

THE bridge upon the Meuse River in Belgium, at Bouvignes, is a recent example of reinforced concrete work. Lying as it does in the region of the war, it is not unreasonable to suppose that, like other bridges in Belgium, it was exposed to more or less damage. The present bridge has a total length between abutments of 393 feet, being made up of a mid-river span 110 feet long and two end spans, each of about 140 feet. Reinforced concrete on the French Hennebique system is used here. Outside width of the bridge is 13 feet, including wagon way and two footways, and the former is paved with compressed asphalt laid directly on the reinforced concrete bridge-planking. This makes the roadway very elastic and is found to be an excellent method. Some points about the building of the two piers in the river may be of interest. This work was carried out by means of caissons built of reinforced concrete and further stiffened by webs of the same. After the cement had set, the caisson was sunk upon the prepared rock surface. Two layers of cement sacks had been put in place upon the rock by a squad of divers so as to form a good level base for receiving the caisson. After lowering upon this prepared surface, a diver went down to inspect the inside and see that all was in place, after which concrete was run into the caisson so as to fill up to about 8 feet on the bottom. When this layer had set, the caisson was pumped out by turbine pump on the scaffolding, and when empty the filling of the caisson was then carried on by 8-inch layers of concrete, each layer being well pounded in place, thus reaching the top of the caisson. Height above the foundation is about 20 feet, and the top projects 3 feet out of the water. The foundations for abutments are of interest as having been laid by the use of the "compressol" concrete well system, using a pointed ram of the pile-driver kind to sink a deep hole and compress the soil around it, the well then being filled with rock pounded in, and then with rock and cement layers. This gave a solid foundation for the abutments, these being of reinforced concrete, and the iron work is consolidated with the concrete of the ground wells so as to make a monolith construction. The North Belgian Railroad runs along one bank of the river.

# SCIENTIFIC AMERICAN

**Founded 1845**

**NEW YORK, SATURDAY, APRIL 10, 1915**

Published by Munn & Co., Incorporated. Charles Allen Munn, President; Frederick Converse Beach, Secretary
Orson D. Munn, Treasurer
all at 233 Broadway, New York

Entered at the Post Office of New York, N. Y., as Second Class Matter
Entered as Second Class Matter at the Post Office Department, Canada.

Trade Mark Registered in the United States Patent Office




**Subscription Rates**

| | |
|---|---|
| Subscription one year................................ | $3.00 |
| Postage prepaid in United States and possessions. Mexico, Cuba, and Panama | |
| Subscriptions for Foreign Countries, one year, postage prepaid, | 4.50 |
| Subscriptions for Canada, one year, postage prepaid......... | 3.75 |

**The Scientific American Publications**

| | | |
|---|---|---|
| Scientific American (established 1845).......... | per year. | $3.00 |
| Scientific American Supplement established 1876. | " " | 5.00 |
| American Homes and Gardens................ | " " | 3.00 |

The combined subscription rates and rates to foreign countries including Canada, will be furnished upon application.
Remit by postal or express money order, bank draft or check

**Munn & Co., Inc., 233 Broadway, New York**

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp* the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.


*The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.*

## The Submarine Disaster

THE shocking disaster, at Honolulu, to "F-4," one of our later destroyers, involving the loss of the boat and the whole of its crew, has brought home to the people of the United States a realization of the ever-present perils which attend the operation of submarines.

In the earlier years of the development of this type of craft, accidents of the kind which has now happened to "F-4" were alarmingly frequent. During the past decade death has taken heavy toll of the men who go down into the sea on underwater craft, and particularly among those nations, France, Great Britain, and Germany, which have been active in the construction and trying out of the submarine.

Bearing this in mind, and remembering that we have at the present time built and under construction in the United States Navy over half a hundred submarines, and that our officers and crew have been engaged in handling these vessels for the past fifteen years, there is a mournful satisfaction in knowing that the disaster to "F-4" is the first fatal accident that has occurred in our submarine service. There have been accidents, of course. More than once our boats have sunk to the bottom and remained there much longer than their commanders intended, causing thereby no little anxiety. But in every case the seat of the trouble was located and the boat brought safely back to the surface.

The cause of the loss of "F-4" remains at the present writing a mystery. Doubtless, by the time this issue appears the wreck will have been brought ashore and the cause of the disaster ascertained. It would be a misfortune if the loss of this boat shook the confidence of the public in this new form of naval warfare. In the service it is understood that foundering is only one among several forms of accident to which the submarine is liable, and the fact that something went wrong on this boat will not serve to shake the confidence of men or officers. Indeed, it only takes a few minutes' conversation with them to realize that, in the service, the submarine is regarded with growing appreciation. No professional man ventures to set a limit to its potentialities when it shall have achieved its maximum development in size, speed, seagoing qualities, and extended radius of action.

The great length of time required to bring "F-4" to the surface after it had been located suggests that, since we have a submarine fleet of such considerable proportions, the Navy should build at least two of those powerful, floating, submarine-salvage ships with which the foreign navies are equipped. More than once we have given illustrated descriptions of these vessels, and we understand that they have done very efficient work in emergencies. The United States Navy ought to have one of these craft in the Pacific and another in the Atlantic, centrally located with regard to our submarine bases.

Although the submarine, because of the success of the Germans in sinking some of the slower warships and many of the slower merchant vessels of the enemy, has given the public an exaggerated estimate of its present military value, no such impression has been made upon the officers and men of our own service. The submarine, it is admitted, has done excellent work within the limits of its capacity; but it is realized that its speed and cruising radius, especially in the submerged condition, must be greatly increased before it can exercise a controlling influence upon naval operations as a whole.

## Battleships With Battle-cruiser Speed

THE principal objection on the part of our Navy Department to the construction of battle-cruisers is that their side armor is too light to enable them to stand in the line with battleships, with any hope of keeping out the heavy armor-piercing shells of the enemy's battleships. The great strategical and tactical value of high speed is admitted; but the sacrifice of armor involved has been looked upon as an insuperable objection, at least until our battleship line has been brought up to the standard of strength called for by the General Board of the Navy.

That objection, however, has been met in those five remarkable ships known as the "Queen Elizabeth" class. Here we have dreadnoughts carrying the heaviest guns afloat, protected by 13 or 14 inches of armor on the water-line and turrets, and nevertheless able to steam at 26 knots or over in service. Twenty-five knots was the speed called for, but, as usual, the Parsons turbines have pulled an extra knot or two out of these ships, and the whole of the group will be capable of doing from 26 to 27 knots when called upon. The succeeding ships of the "Royal Sovereign" class, it is true, have dropped back to the 21-knot standard speed for dreadnought battleships. Evidently it was the design of the British Admiralty to provide the commander-in-chief of the fleet with a division whose combination of power, protection, and speed would render it of the highest strategical and tactical value in the operations of a great war. It can accept or refuse battle at will, and, by virtue of its speed, it can attack the rearmost ships of a fleeing enemy and delay him, until the main fleet can come up and engage.

## Forts vs. Battleships

THERE seems to be little doubt that something has gone wrong with the attack of the Allies upon the forts which line both sides of the Straits of the Dardanelles. Since the grand attack in force, when three battleships were sunk and several severely punished, there has been a perceptible lull in the operations. We hear less talk about forcing the Dardanelles and crushing the fortifications by overwhelming gun-fire, and more about the necessity for capturing the positions from the land side.

Of course, the situation of the straits is a peculiarly difficult one for an attacking force, especially if the endeavor to force the straits is made from the westward. This is due to the fact that a very swift current sets from the Sea of Marmora to the Mediterranean, and that this renders it possible for the Turks to transfer the floating mine into a mobile engine of destruction. It will be remembered that the British Admiralty attributed the loss of the three battleships to the fact that the Turks let loose, at the easterly end of the straits, a large number of mines, which, coming down with the current, in due course found their quarry.

It would be an interesting *dénouement* of the naval operations of the Dardanelles, if the forts should be taken in the rear and their guns destroyed by field armies. Unless the Dardanelles forts are better protected than our own coast forts against being taken in reverse, or from the rear, the chances of their speedy reduction are very good indeed; but in view of the fact that the fortifications, at least on the European side, can readily be approached by landing parties from ships, it is fairly certain that the landward approaches are capable of offering strong resistance to attack. In which case, it is certain that the Turks, who have proved themselves to be very formidable, when, as at Plevna, they are fighting behind field works and in open trenches, will put up a strong defense. It is likely that the most interesting phase, and certainly the most elaborate, in this attempt to force the straits is yet to come.

## Wanted—A Polyglot Scientific Dictionary

OF dictionaries of a strictly lexical character there are two principal types, viz., the dictionary which consists of words with their definitions, and the dictionary which consists of words belonging to one language with their equivalents in one or more other languages. In our superscription we have reference primarily to a work of the second type, though the inclusion of a certain number of definitions, for the purpose of identifying positively such terms as might be ambiguous without them, would certainly be a desirable, and would probably be an essential, feature.

An Italian proverb has it that translators are traitors ("Traduttori traditori"). Reasonably faithful translations are certainly far from common, while perfect translations hardly exist. An unsatisfactory translation does not, of course, necessarily argue either incompetence or negligence on the part of the translator. There are certain insuperable difficulties inherent in his task. Thus, it is impossible to render faithfully into English the turns of expression in other languages for which the English language offers no precise equivalents—and their name is legion. Again, the faithful rendering of a foreign phrase often makes intolerable reading in English and must therefore be avoided.

In contradistinction to these incurable difficulties in the way of good translating, the translator is confronted by one which is not incurable, viz., inadequate dictionaries. Even for the vocabulary of general literature there are very few good interlingual word-books. There is, for example, no good large French-English dictionary, though there are (at last!) some excellent small ones. The average French-English, or anything-else-English, dictionary is notoriously crude and out of date. As to the latter defect, it may be noted that up to ten years ago most "new" and "revised" works of this class failed to recognize the existence of the telephone, while even contemporary publications ignore the existence of a number of every-day expressions (we do not refer to technical terms) connected with that familiar institution.

The situation with respect to the scientific vocabulary presents the anomaly that while, on the one hand, we have some admirable bilingual and multilingual word-books of technological scope, we have nothing of the sort for pure science. A certain recent word-book in six languages, of which about a dozen volumes have been issued, each devoted to a particular branch of technology, is an almost ideal work in both plan and contents, and there are several other good technological dictionaries in two or more languages.

A polyglot dictionary of non-technological scientific terms is an urgent desideratum, not only for the use of translators, but for everybody who has occasion to read scientific literature in foreign languages. What institution or society or individual philanthropist will undertake to supply this need?

## War and the Newspapers

AFTER a time one gets used to the vagaries of the newspaper man in handling war news. The old tiresome picture of the body of bluejackets labeled "Marines," with never a marine in sight, hardly provokes a smile, so old and so time-worn is it. We grin faintly instead of emitting howls of unholy joy when we see a picture of 3-inch field guns labeled "Machine guns in action." Even the richest one of the assortment, printed now these many weary months—we refer to the photograph of a parked battery with the gunners lolling comfortably about under the trails and labeled "French (or German or British or Russian) artillery in action"—hardly provokes more than a tickled chortle or so. But we claim that even the most *blasé* of the *blasé* will contort his visage over this extract from an inspired San Francisco paper: "The German troops fire spit balls with a velocity of 2,900 feet per second." All of which makes us wonder whether we had under-estimated the efficacy of the missiles prepared in our youthful days, or whether the German bullet is as merciful as the German disposition is alleged to be. The dum-dum controversy, too, has raged in the pages of the journals. Sometimes inspired editors commented thereon, with results that increased the sale of their papers, and decreased the sale of the intentionally comic weeklies.

## A Co-operative Health Board

SEVEN Massachusetts towns co-operate to get an efficient public health service that no one of them could afford to pay for by itself. They abandoned all or part (as they desired) of their other public health resources, and put their medical inspection work in the hands of a central organization under Prof. Phelps of the Massachusetts Institute of Technology.

This seven-town organization (Wellesley, Framingham, Weston, Needham, Melrose, Winchester, and Canton) engaged an administrative officer, a chemist and bacteriologist, a plumbing and sanitary inspector, and a corps of assistants. And these men have all been worth their salaries, many times over. They have regular office hours, which they keep in each of the towns; and they maintain stations at strategic points, from which they distribute such things as antitoxin for diphtheria patients and virus for vaccination. They make diagnoses of diphtheria, typhoid fever, and other infectious diseases by telephone, and then the doctors can go ahead intelligently and treat the patients. That is the way the health of 55,000 people is safeguarded. These seven enterprising towns have as good a health service as is given by many a large city health department, and many a large city is not so well served.

Papers in every halmet, village and township, from Portland, Me., to Point Lima, Cal., and from St. Augustine, Fla., to Portland, O., please copy.

## Electricity

**Insulation of Electric Ovens.**—In a recent issue of the *Electrical World*, Messrs. A. E. Kennelly, F. D. Everett, and A. A. Prior, described some experiments of theirs upon the heat insulation of electric cooking utensils in which they show what an enormous saving of energy may be obtained by the use of better insulation against the useless radiation of heat. They find that in an oven with single walls the consumption was 40 watts per degree Centigrade as against 25 watts per degree with double walls. When the space between the walls was packed with cotton waste, the energy consumption was reduced to 15 watts while with a packing of mineral wool, this was lowered to between 12 and 13 watts.

**Novel Ventilation Indicator for Turbine Driven Generators.**—Appreciating the importance of maintaining a constant current of cooling air through a turbine generator, the United Electric Light and Power Company of New York has devised an ingenious indicator to show any interruptions in the cooling current. A pilot lamp is provided in whose circuit is a mercury switch. This switch is held in closed position by a jet of air from the air duct blowing against a vane on the switch. Whenever the air pressure drops, the pressure on the vane is correspondingly lowered and the switch is opened by a counter weight. Thus the pilot lamp is extinguished indicating to the operator at once that there is some trouble with the air supply for that particular generator.

**A Surgeon's Divining Rod.**—An ingenious method of locating needles in tissues was recently described by G. H. Monks in the *Boston Medical and Surgical Journal.* First the buried needle is magnetized by passing a magnet over the locality where the needle is suspected to be. Then another needle, suspended from a fine silk thread, is passed over the same locality, when the poles of the buried needle will attract unlike poles of the examining needle, causing the latter to swing around parallel to the axis of the buried needle, and if one pair of poles is nearer than the other, there will be a corresponding dip of the examining needle, somewhat after the manner of the "divining rod." By this means the location of the buried needle may be determined with precision. This provides a far simpler and readier means of locating a buried piece of steel than the use of Röntgen ray apparatus.

**Vacuum Tube Protection for Telephone Lines.**—Writing in a recent issue of the *Elektrotechnische Zeitschrift*, Fritz Schroeter describes a type of vacuum tube which can be used to protect telephone lines against voltages as low as 130. The cathode of the tube is a fused alloy of potassium and sodium, while the anode, consisting of an aluminium rod surrounded by a protective tube, projects down to within a few millimeters of the cathode. The tube contains either helium, neon or argon or a mixture of these gases, at a pressure of one to three millimeters. If by any accident the telephone line should become charged with more than 130 volts, a brush discharge would take place in the vacuum tube, causing sufficient evaporation of the cathode to produce an arc and this would allow sufficient passage of current to melt a fuse in the line. As soon as the dangerous voltage is interrupted, the vacuum tube is automatically restored to normal conditions. By another arrangement the anode of the vacuum tube connects with the line through a coil of high resistance, while the cathode of the tube is connected, of course, to the ground. When the critical voltage is passed current passing through the tube also energizes the coil thereby attracting an armature which opens a switch in the line.

**Concentric Wiring.**—The question of adopting the European system of concentric wiring is occupying a great deal of public attention at the present time. In Europe houses are very cheaply wired by the use of conductors consisting of an inner core surrounded by insulating material and covered with an outer conductor that is bare. This constitutes the return wire of the circuit and must be thoroughly grounded. In discussing this type of wiring, Mr. S. E. Doane recently pointed out the fact that it is merely an evolution of our present system in this country. The practice of placing the two conductors or circuits within a metallic tube or conduit was necessarily followed by a rule of the National Electric Code requiring that this conduit be continuous from outlet to outlet, and permanently grounded, lest the insulation become abraded and there be a leakage from the conductors to the conduit. But in central stations with a grounded neutral wire, there is practically no difference of potential between that wire and the grounded conduit. Hence the insulation about this neutral wire may be dispensed with or put on the potential wire to increase the margin of safety. Having arrived at this point there is no reason why the bare grounded wire within the conduit should not be dispensed with and the conduit itself be used in its place. Thus we arrive at the concentric wiring. In this connection it is interesting to note that in Germany, owing to the scarcity of copper and rubber, these materials have been largely eliminated from concentric wiring. Soft iron and aluminium have displaced the copper and paper is used in place of rubber for the insulation.

## Science

**The Publications of the Carnegie Institution** amounted, up to the close of 1914, to 276 volumes, aggregating more than 73,000 pages. Of these a total of 132,430 copies had been distributed. As the Institution observes a very conservative policy with regard to the gratuitous distribution of its publications, the above output includes copies sold to the total value of about $94,000.

**Pre-historic Man in Australia.**—At the recent meeting of the British Association in Australia Professors Edgeworth David and Wilson described a completely mineralized human skull found near Warwick in the Darling Downs of Queensland. It probably dates from a period when the great fossil marsupials were still living and is earlier than any other human remains hitherto found in Australia.

**Prices of Chemicals Kiting.**—The prices of a very large number of chemicals that have been affected by the embargo on German commerce have advanced tremendously of late, and even at the exorbitant prices quoted there is very little of any of these articles to be had. Carbolic acid has gone from 12 cents a pound, wholesale, to $1.50; salicylic acid from 30 cents to $1.60; phenacetin from $2.75 to $8, and benzole from 75 cents to $4 a gallon. Naturally all potash salts have gone off in proportion, and now permanganate of potash is quoted at 40 cents as against 11 cents of a few months ago, while there is a corresponding shortage and advance in price of other salts of this necessary chemical.

**How Timber is Frequently Damaged.**—Experiments at the Forest Service laboratory of the Department of Agriculture have determined that the strength of a piece of wood may be seriously impaired by slight compression failures due to rough handling. Dropping a beam across a skid may cause a compression failure at the point at which the beam strikes the skid and it will be at this point that the beam gives way when it breaks under a strain too severe for the weakened fibers to withstand. Hitherto unaccountable breakage in hickory wagon spokes and other presumably strong materials are now attributed to compression failures caused by wind storms in the period of growth or by hard usage in lumbering and manufacturing processes. These compression failures show themselves in the form of little diagonal streaks or wrinkles across the grain, and are always a sure sign of weakness.

**The Radio-atmometer.**—One variety of Prof. Livingston's porous-cup atmometer, now so widely used for evaporation measurements in connection with plant physiology, is the radio-atmometer, the purpose of which is to measure the effective intensity of radiant energy as this influences evaporation from plant surfaces (as distinguished from the evaporating power of the air itself). This instrument comprises two otherwise similar evaporating surfaces, one of which is white and the other black. The radiation falling upon the former is mainly reflected, while that falling upon the latter is mainly absorbed. The two surfaces are equally affected by the evaporating power of the air; hence the difference between their evaporational losses is an approximate measure of the radiation absorbed by the black one. The results obtained with this instrument are more or less applicable to the study of evaporation from dark-colored plant surfaces under sunshine. Livingston has recently improved this apparatus by substituting spherical for cylindrical cups, thus giving the same angle of exposure to the sun's rays at all hours of the day, and in all seasons and latitudes.

**Does Sea-water Contain Free Carbon Dioxide?**—The Department of Marine Biology of the Carnegie Institution has recently conducted a number of investigations at its Tortugas laboratory with a view to settling this question. The absence of free carbon dioxide would prove that sea-water has no power to dissolve limestone, and that solution has had no part in the formation of the lagoons of coral atolls and barrier reefs. Numerous samples of the lagoon water of the Tortugas atoll were analyzed by Mr. R. B. Dole, without revealing the presence of any free carbon dioxide. On the other hand, Dr. Shiro Tashiro has reached a different result from tests of this water with extremely delicate apparatus of his invention known as the "biometer," designed especially for studying the rate of metabolism in organisms as measured by their production of carbon dioxide. This device utilizes a drop of barium hydrate, upon the surface of which crystals of barium carbonate form if there be carbon dioxide present in the surrounding atmosphere. It is so delicate that it enables the investigator to detect a quantity of this substance as small as one ten-millionth of a gramme. Dr. Tashiro has made the interesting discovery that carbon dioxide is given off into the atmosphere from the sea-water of Tortugas under normal atmospheric pressure and temperature, and this leads to the suspicion that uncombined carbon dioxide may be present in the water, though the observed phenomena may be due entirely to the decomposition of bicarbonates in the water. The subject is still under investigation.

## Aeronautics

**A Compounded Aeroplane.**—In patent No. 1,127,028 Thomas Alva Edison Lake of Milford, Conn., shows a flying machine in which a plurality of flexible aeroplanes are arranged in step-like order fore and aft and so disposed that no one of the aeroplanes offers resistance to the adjacent one when descending on an even keel.

**Flying on the Ground.**—A recreation apparatus has been patented by Henry Salsbury of London, England, No. 1,127,094, wherein a car is suspended above a surface and is given motions similar to those of an aeroplane in flight, and animated pictures, taken from mid air, are projected on the surface below to convey the sensation of an aeroplane to the occupants of the car.

**Air Compressed by the Parachute Fills the Life Preserver.**—Jozsef Vig of Witherbee, New York, has patented, No. 1,131,300, a combined parachute and life preserver in which devices may be operated to cause the parachute to open automatically. In descending air is forced by the descent of the parachute through suitable passages and joints into the life preserver which latter may encircle the wearer in the usual manner so that the operator will be gradually lowered in the water and when in the water will be buoyed by the life preserver.

**Another Parachute Attachment for Airships.**—Anton Mayer of Chicago, Ill., in a patent, No. 1,125,365, supports a parachute normally housed by a plurality of frame members between front and rear portions of the airship and in operation in case of accident the greater weight of the forward end of the airship will cause such end to dip downwardly. The safety equipment provided enables the aviator to check the descent by opening the ignition circuit of his engine and also effecting the opening of the parachute.

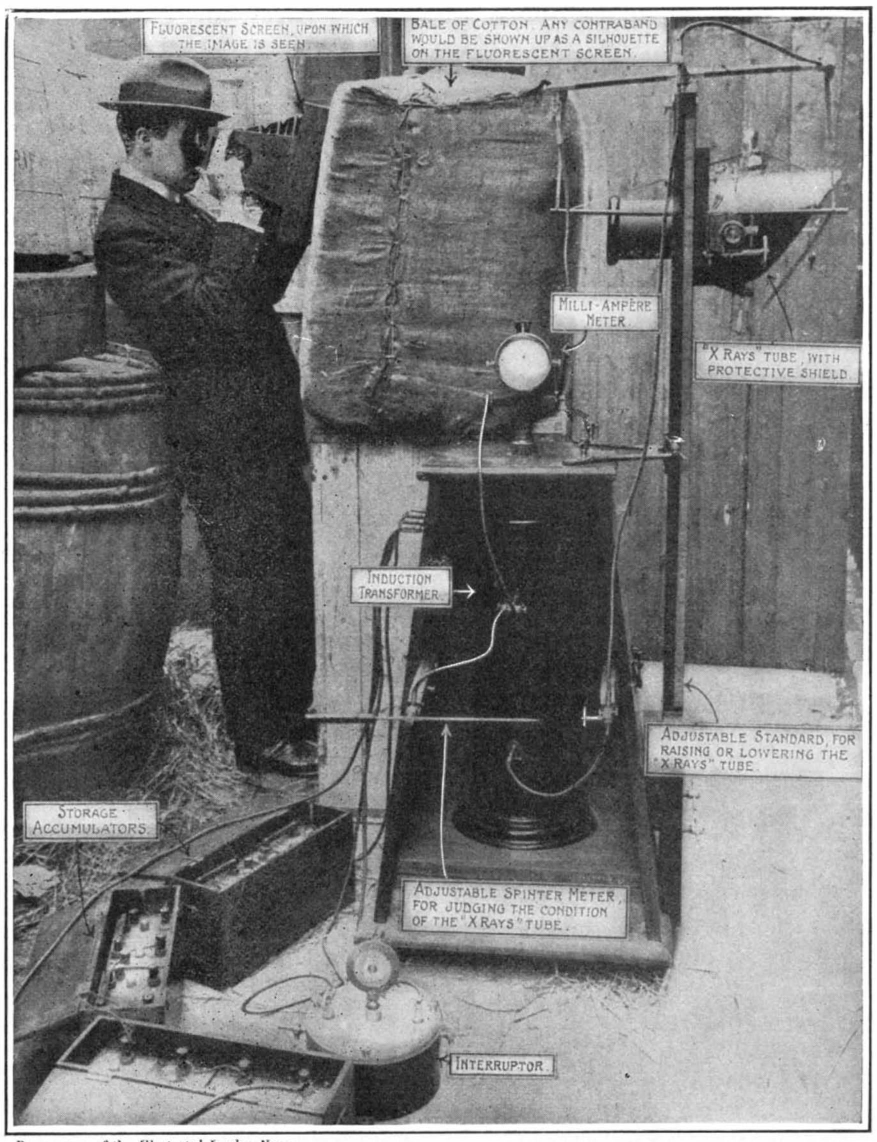
**A Speedometer for Aeroplanes.**—In patent No. 1,123,253 O. A. Danielson of New York city provides for determining the speed of aerial machines by means of a direct reading instrument which will do for the aeroplane what the familiar speedometer does for an automobile. By his improvement he sights and observes an object on the earth by a movable sight on the aeroplane. Then, as the aeroplane advances, he moves the aeroplane sight rearwardly to such extent as to keep it directly over the earth object, and then determines the speed of rearward movement of such sight necessary to keep it over the earth object and this speed is the speed of the aeroplane.

**Aeroplane Operations in the War.**—The activity of aeroplanes on both sides during the war has been both remarkable and sensational, not only in the work of scouting and observation, but also in bomb dropping raids, and a noticeable feature of these operations has been the superiority of the French and English machines over those used by the Germans, which have proved greatly deficient in both speed and climbing powers as compared with their opponents. In several instances reported the machines of the allies have fairly outflown those of their adversaries, which were so much faster and could climb so much more rapidly that they were able to outmaneuver the Germans and take positions of such advantage that the only safety of the latter was prompt flight.

**Lessons of the War.**—According to a statement made by Baron d'Orcy, in France the machines have been divided into three classes: the destroyer, artillery spotter and scout aeroplanes. On each of these lines development is advancing rapidly. The destroyer carries a gun and bomb-dropping machine and is of the pusher type, with propeller behind and gun forward, giving a wide range of fire in attack, and a great advantage over the German 'Taubes," which have the tractor screw in front. On the second class of aeroplanes, the artillery spotters, the needs are light armor, owing to the low altitude at which these machines must fly in observation—as close as 1,000 meters. At this height they can be reached by rifle bullets, and protection from these is needed. The destroyers fly twice as high and need no armor. Neither one of them has had reason to fear the anti-aircraft guns, which are very inaccurate in aim. The spotters also are equipped with wireless apparatus enabling them to keep in constant communication with the batteries to which they are attached. Not all of these instruments are able to receive, but that is not of as much importance as the ability to report the enemy's position and the effect of the fire directed against it. In speed it is important that these machines be able to fly slowly when they wish to linger above a hostile position or suspected position. They also must be able to climb quickly out of danger. So variable speed is being developed. In the third class is the fast light scout, taking the place of cavalry in reconnaisance and bearing despatches that cannot be trusted to wireless. These are one-man machines without armament other than the pilot's rifle or automatic revolver, and most of them are making little more than 80 miles an hour. The higher speed machines have limitations in landing, and there are a very few of them in use, principally in the neighborhood of Paris, which is well protected by aircraft.

## Searching for Contraband With X-Rays

WHEN mention is made of Roentgen rays in connection with the present war, we are apt to think first of their use in hospitals to locate bullets, fractures, dislocations, etc., and this is quite natural because there is no doubt that many lives have been saved and much suffering has been avoided by the use of these penetrating rays. But it is not only in the hospital that we find this discovery of Prof. Roentgen put to practical service. The fighting nations are very particular to keep from entering the territory of the enemy any goods that might be used in military service. This entails the endless task of examining all shipments, and the value of any means of seeing through a parcel or bulky package instead of opening it up and examining it in detail is clearly evident. Even in times of peace X-rays were used to examine packages which might contain dutiable goods. Naturally in time of war this method of examination has proved even more important. One of the most difficult of shipments to examine is that of the cotton bale, which obviously cannot be opened and thoroughly inspected and then restored to its original proportions without special baling machinery. What more simple, then, to pass Roentgen rays through it, and by means of a fluoroscope note whether the bale contains any foreign substances? Anything more dense than cotton would be shown up as a silhouette on the fluorescent screen. The accompanying photograph, reproduced by courtesy of the *Illustrated London News*, shows the type of apparatus used in France and in Russia. Even in this country cargoes are X-rayed before being accepted on British ships. Not long ago we illustrated the apparatus used in New York by representatives of the British government. The value of such a search was demonstrated in one case by the discovery of four pounds of rubber sheeting in each of 178 bales of cotton waste. Needless to say, the consignment was refused.



By courtesy of the *Illustrated London News*.

**Searching for contraband in a cotton bale rendered transparent by means of X-rays.**

## Wireless Telegraphy and Railroading

**By H. D. Schedler**

THE Lackawanna Railroad Company undoubtedly is the first railroad company to employ wireless telegraphy successfully. This company first made experiments with the wireless telegraph and telephone in 1909, but the apparatus at that time was crude and not sufficiently developed to be of practical use. Mr. L. B. Foley, who has charge of that part of the railroad, experimented further. During the early part of 1913 towers were erected and wireless telegraph stations installed at Scranton and Binghamton, and it was found that the service between these points was equally as satisfactory as the Morse telegraph, and could be relied upon when the telegraph and telephone service was impaired.

The first passenger train was equipped with wireless telegraphy, and messages transmitted to and from the train and the fixed stations at Scranton and Binghamton on November 21st, 1913. At the present time the company has the following fixed stations:

| Location | Call | Wave Lengths in meters | Height of Towers in feet | Capacity of station in Kw. |
|---|---|---|---|---|
| Hoboken | WBU | 3,000 | 402 | 5 |
| Scranton | WPT | 3,000 | 175 | 2 |
| Binghamton | WBT | 1,800 | 165 | 2 |
| Buffalo | WBS | 1,600 | 150 | 2 |

These stations are all equipped with Marconi apparatus.

Besides these fixed stations several of the limited trains are equipped with sets. The apparatus aboard the trains are similar in principle to that of the fixed stations. The motor generator on the train is operated on 30 volts direct current from the car lighting generator, which carries on its line a set of storage cells. This motor generator draws about 40 amperes, and supplies 500 cycle alternating current at 250 volts for the radio transmitter, including a 10-unit quenching gap, three glass jar condensers of suitable capacity each, and the usual radio transformers.

From a moving train to a fixed station a distance of 130 miles can be covered. Owing to the low antennae on the passenger cars, a greater distance than this has not been covered, but messages have been received from a fixed station over a distance of 200 miles. The aerials on the trains must be low on account of bridges and other overhead interferences. The speed of the train, or its change of direction while *en route*, does not have any effect upon the transmission and reception of signals, and it is queer that communication to and from the train is not impaired while the train is passing through tunnels.

The train radio service has been used for various purposes, such as reporting the number of passengers on board destined to connecting lines, for providing additional, or cutting out cars at divisional points, in ordering an ambulance at next train stop for persons taken ill on a train, and handling commercial telegrams for passengers. In one instance a telegram was filed by a passenger on the train for a resident in the city of Scranton, the message transmitted to its destination, delivered, and the reply received by the sender in twenty minutes.

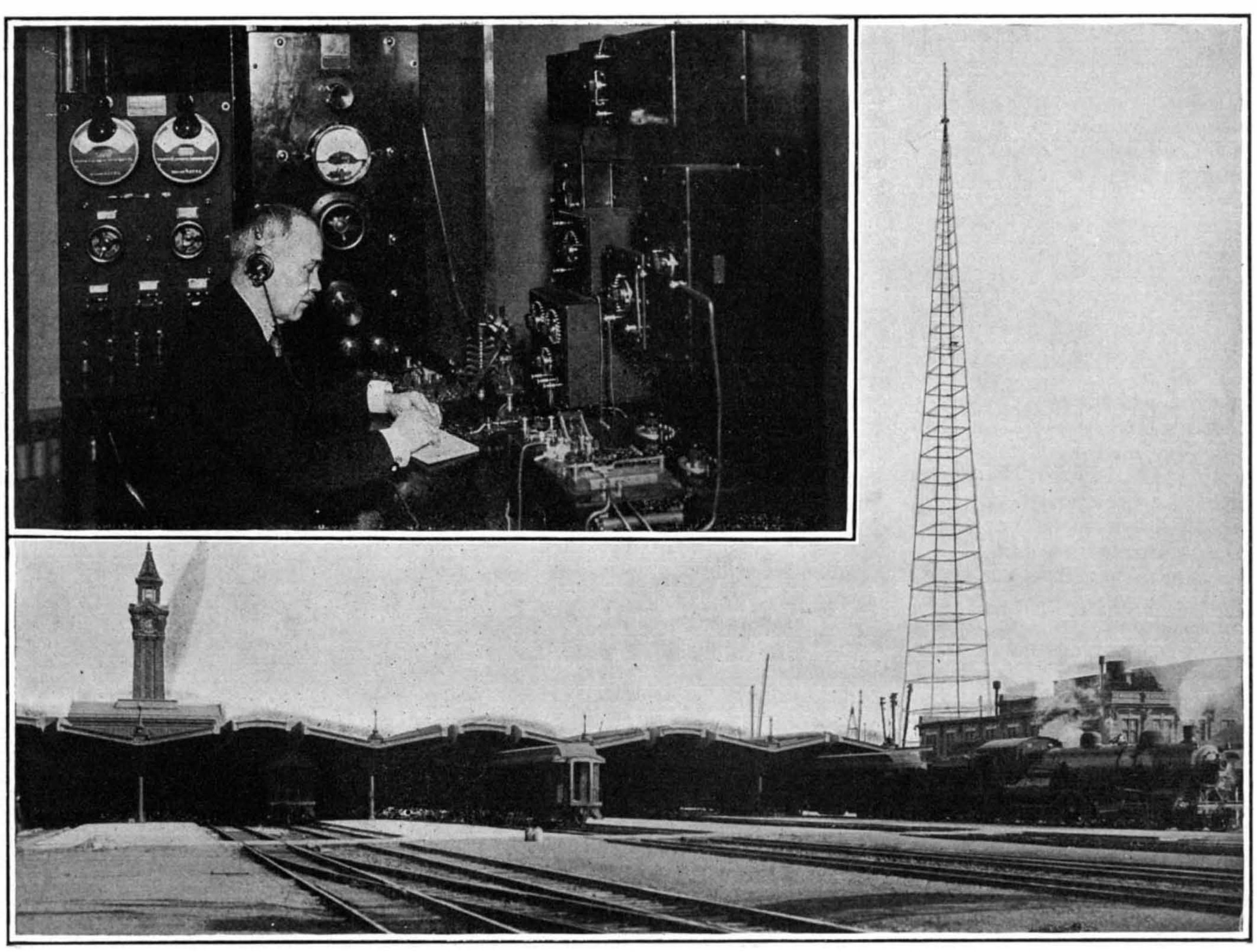
On April 1st last year a special train equipped with wireless telegraph, ran from Ithaca to Hoboken, carrying 550 Cornell students. The train operator handled 128 radiograms from the train to fixed stations at Binghamton, Scranton, and Hoboken, for students who were on their way to their homes for Easter.

The wireless telegraph can be depended on between fixed stations and between moving trains and fixed stations. There are many uses for the wireless telegraph in railroad train operation. It enables the dispatcher to communicate direct with the train, and train orders can be transmitted as accurately and reliably as by telegraph or telephone.

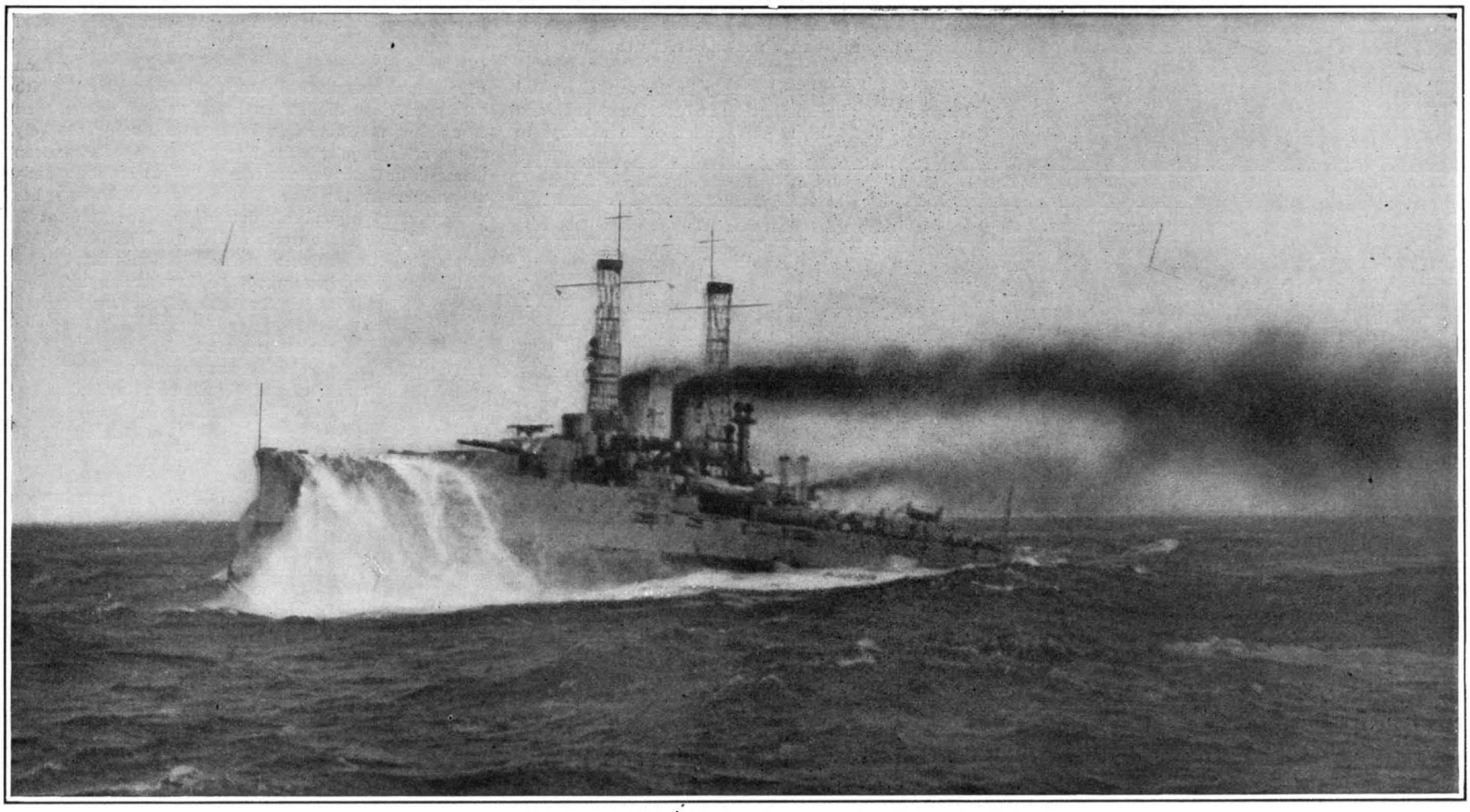
The wireless telegraph serves as an auxiliary method of communication, in addition to the telegraph and telephone, in the event of interruption to wire facilities, and has already proved its practicability and efficiency under such conditions, not only between fixed stations, but also between moving train and fixed stations, and the results obtained by the Lackawanna Railroad during the past year have been valuable in many ways. It is the intention of the company to extend the service over the entire system.

Each station (wireless) at each divisional point is located within a few feet of the dispatcher's office; and in event of total wire failures on any part of the road, the wireless station is immediately resorted to. Operators at divisional

(*Concluded on page 349.*)



**Running a railroad by wireless. The wireless equipment of the Lackawanna Railroad.**





**Date**, 1911. **Tons**, 21,825. **Speed**, 21 knots. **Guns**, Ten 12-inch, sixteen 5-inch. **Torpedo tubes**, 2. **Belt**, 11-inch.

**U. S. S. "Utah" driving into a heavy head sea in the North Atlantic.**

# An Analysis of Our Naval Standing—I

## Strength of United States Fleet has been Determined by Temporary Emergencies

By George von L. Meyer, Former Secretary of the Navy

FRANCE, fourth as a naval power last year, has taken the place of the United States, the French government having expedited work on all ships which were in process of construction at the time the war began. The Naval Intelligence Office announced, last July, that if all vessels then building were completed French tonnage would be greater than that of the United States.

On our part, we are not even following a programme of new construction intended to replace those vessels which have been, or will soon be, condemned because unfit for service on account of age. A feeble attempt has been made to convince the public that the Panama Canal *doubles* the fleet, but this is an absurdity. It has also been said that by the time the present war is concluded the United States Navy will be the first, the losses of the belligerents relegating them to lower rank in tonnage. Yet experts of the Navy Department refuse to consider this decrease by attrition as indicating a relative increase for the United States, because what counts is not the number of ships lost, but the number of those being added to the outstanding fleets. There is no hope, therefore, that we can increase our tonnage by a corresponding decrease in the tonnage of the other naval powers. Furthermore, these losses may remain relatively insignificant, if viewed in the light of the naval strength of the belligerents. Up to the time of writing the engagements of the battle cruisers in the North Sea and off the Falkland Islands have been the only naval encounters of any consequence, but yet inconsequential in mere tonnage.

The most serious thing about our interests in the Navy is that the advocates of the "biggest" navy and the advocates of "no navy" are not defeating each other in the legislative debates on the naval appropriation bill, but they are defeating all attempts to discuss intelligently the topic of national defense.

Personally, I am not committed to a great navy. I am, however, in favor of a strong fleet with all necessary auxiliaries. The situation in the United States to-day, when even neutral American shipping is in danger, should warn us that preparedness is a wise thing, and that we can never hope to expand our foreign commerce without an adequate navy to protect it.

Our fleet, as it exists to-day, is the growth of an inadequately expressed public opinion, and that growth has followed the laws of expediency to meet temporary emergencies and has had little or no relation to the true meaning of naval power, or to our need of naval power. The naval policy of the United States should be to possess a fleet powerful enough to prevent or answer any challenge to the country's well-established national policies. It is obvious that the absolute strength necessary to accomplish this is a question that depends upon the national policies of possible challengers and the force that they can bring against us. This force is relative and varies with their naval policies and building programmes. Briefly, our fleet should be the equal or superior to that of any possible enemy, and in order to arrive at any satisfactory conclusion on this debatable point, we must base our calculations upon the careful estimates and forecasts of the General Board as to what would be the naval development of those foreign countries with which conflict might be probable.

In 1903 the General Board formulated its opinion as to what our naval development should be, and its forecast was that a fleet of 48 battleships, with the attendant lesser units and auxiliaries, ready for action by 1920, would accomplish this result. This forecast has proved, after many years, remarkably accurate. Meanwhile the absence of any definite naval policy—which means congressional opposition to the recommendations of several administrations—has lost us second and then third place, and if continued will make of us an inferior naval power.

During my incumbency as Secretary of the Navy in the Taft Administration, congressional opposition to the Navy Department's recommendations was generally based on the theory that the United States will *never* have a war. But history shows that wars come at times with little or no warning. The European war was an actuality overnight and in ten days as many nations were allies or enemies in what will be the most titanic struggle known to man.

A force of circumstances, over which the United States has no control, is beginning to involve the safety of the lives of American citizens as well as the protection of our interests. Yet we must not forget in this instance that our Navy is the arm and measure of strength of our foreign policy and diplomacy, and a deficient navy will weaken both this diplomacy and policy.

The war has shown us that, commercially, financially and industrially, we are not isolated from Europe, to say nothing of the rest of the world, and the opening of the Panama Canal lessens this isolation because it brings so much foreign shipping almost at our door.

In estimating upon a fleet of forty-eight battleships of the line, with the appropriate number of lesser units and auxiliaries to complete and maintain a fighting whole, and a personnel of officers and enlisted men that shall grow and keep pace with the material fleet, the General Board tentatively figured that this full strength be attained by 1920. But although Italy's naval programme extends to 1918, France's to 1920, Germany's to 1917, and England's existing law is to develop a supremacy of 60 per cent in vessels of the dreadnought type over Germany, the American procedure has been to reduce and disregard to a great extent the recommendations of the General Board and those of the Navy Department when in sympathy with the General Board and thus fail to meet the needs and requirements of the Navy. It will be impossible for the board's plans to be realized by 1920, because the estimates and recommendations for 1916 have already been submitted, and judging by present indications the United States will gain little in the next four years.

The building programme recommended this year differs little from the recommendations of last year. Secretary Daniels follows the policy recommended by the General Board, but reduces the number of vessels asked for. His estimates include two dreadnoughts, six destroyers, eight submarines (one sea-going and seven coast-defense), one gunboat and one oiler. The General Board recommended to the Secretary of the Navy four battleships, sixteen destroyers, three fleet submarines, sixteen coast submarines, four scouts, four gunboats, two oil-fuel ships, one destroyer tender, one submarine tender, one navy transport, one hospital ship, one supply ship, and aerial service to the extent of $5,000,000.

Granting that this programme be repeated for the next four years, the United States would in 1920 have forty-eight battleships, if replacements be not considered or no age limit be placed on such vessels. But a navy must be renewed every year, unit by unit, because warships become obsolete after twenty years. A new warship substituting an old one does not increase naval strength, though it may add a few hundred tons to the total, but merely enables a nation to retain her normal naval strength with modern equipment.

Nor can it be for a moment conceded that the Panama Canal will double the fleet, as it has often been stated. The canal will increase the efficiency of the fleet somewhat because it will reduce the time necessary to move a given number of ships from one coast to another, but this rapidity of movement is not the equivalent of a numerical increase of units. The actual advantage of the canal and its value to our Navy is something that can be deduced only in theory, for it involves problems of strategy and warfare with which this article has nothing to do. The Panama Canal will, in effect, be a

naval base, since the docking and repair facilities to be provided there for commercial vessels will meet our naval requirements in time of war. And this leads us to the question of naval bases, to which I shall refer in due time.

The naval standing of the powers last July was as follows:

| | England | | Germany | | U. S. | | France | | Japan | | Russia | | Italy | | Austria | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Built. | Bldg | Built. | Bldg | Built. | Bldg | Built. | Bldg | Built. | Bldg. | Built. | Bldg | Built. | Bldg | Built. | Bldg |
| Battleships (Dreadnoughts) | 20 | 16 | 13 | 7 | 8 | 4 | 4 | 8 | 2 | 4 | .. | 7 | 3 | 7 | 3 | 4 |
| Battleships (Pre-dreadnoughts) | 40 | .. | 20 | .. | 22 | .. | 18 | .. | 13 | .. | 7 | .. | 8 | .. | 6 | .. |
| Coast-defense | .. | .. | 2 | .. | 4 | .. | 1 | .. | 2 | .. | 2 | .. | .. | .. | 6 | .. |
| Battle Cruisers | 9 | 1 | 4 | 4 | .. | .. | .. | .. | 2 | 2 | .. | 4 | .. | .. | .. | .. |
| Armored Cruisers | 34 | .. | 9 | .. | 11 | .. | 20 | .. | 13 | .. | 6 | .. | 9 | .. | 2 | .. |
| Cruisers | 74 | 17 | 41 | 5 | 14 | .. | 9 | .. | 13 | .. | 9 | 8 | 6 | .. | 5 | 5 |
| Destroyers | 167 | 21 | 130 | 24 | 51 | 11 | 84 | 3 | 50 | 2 | 91 | 44 | 36 | 15 | 18 | .. |
| Torpedo Boats | 49 | .. | .. | .. | 13 | .. | 135 | .. | 27 | .. | 14 | .. | 68 | 2 | 39 | 24 |
| Submarines | 75 | 22 | 27 | 18 | 30 | 19 | 64 | 22 | 13 | 2 | 30 | 19 | 19 | 8 | 6 | 6 |

The foregoing table refers only to the completed tonnage, according to the records of the office of Naval Intelligence. On this basis, we occupy third place, but on the basis referred to at the beginning of this article, that of vessels in actual construction if completed, we fall back, yielding our place to France. At all events our tonnage of 765,133, compared with France's 688,840, is susceptible of reduction because our figures include the "Iowa," which will soon be retired. This ship must be replaced, because in armament, protection, speed and other qualities she is not fit to take a place in the line of battle. Needless to say, the "Indiana," "Massachusetts," and "Oregon" are no longer included in our tonnage list. The "Kearsarge," "Kentucky," and "Alabama' will reach their age limit in 1916, while the "Illinois," "Wisconsin," "Maine," "Ohio," and "Missouri" are due for replacement by 1920.

The lowest estimate which the United States Government should consider in the way of a naval programme is, in my opinion, three battleships, twelve destroyers with their tenders and the full quota of auxiliaries. If we build two battleships a year we shall remain, according to the figures available, in the fourth place, provided France does not lose any ships in the course of the present war, but we must bear in mind that the great powers, especially England and France, are maintaining strict secrecy as to their naval increases.

It is obvious, therefore, that our programme will lead nowhere if it is truly the purpose of our people to have an adequate navy. The present fiscal year has been an exception because though Congress appropriated funds for two battleships, a third was made possible by the sale of the "Idaho" and "Mississippi" to Greece last spring, using the funds derived from this transaction for an additional dreadnought. But the "Idaho" and "Mississippi" were both modern ships, built in 1904, and though getting rid of them was a good business proposition, it does not appear that it will increase our tonnage.

Nowadays only dreadnoughts are considered by first-class powers in estimating strength in the first line of battle. Capital ships include the new type of armored cruiser. England and Germany have featured this type of vessel, while Japan has recognized its value, and the latter's programme two years ago called for four armored cruisers and one battleship, reversing the German programme of three battleships and one cruiser. These cruisers are not so heavily armored as the battleship, but they carry big guns and have a speed of 28 knots; they can outspeed anything in order that they may destroy the commerce of the enemy and not be overtaken by a battleship. It is very true that the "Emden" in three months inflicted considerable damage to British shipping in the Pacific and Indian oceans, but the little German cruiser was always in danger of meeting a stronger adversary, as it eventually did. The "Sydney" could never have successfully engaged the "Emden" had the latter been a 28,000-ton battle-cruiser.

The Navy Department has recognized the value of this new type of vessel, but has not systematically recommended its adoption in our Navy owing to our comparatively inferior strength in battleships of the dreadnought type, but while remedying this deficiency this country should also begin to build battle-cruisers, equal if not superior to those of foreign navies. The inclusion of such vessels in this country's building programme is most desirable, but it should be authorized in addition to the battleships needed to maintain our present battleship strength. Having an adequate number of battleships of the first class is the most economical programme in the end. It may be pertinent to remark that if we had had four more battleships like the "Oregon"—an expenditure of about $25,000,000—there would probably have been no war with Spain and we would have saved over $500,000,000 and the lives and property that were lost.

Our Navy, therefore, especially in battleships of the first rank, does not occupy, as can be readily seen, a permanent third place, and while the numerical strength seems to leave nothing to desire, it must be remembered that it is made up of many ancient vessels and others which have reached their limit of usefulness and should be replaced. Provision for this replacement is one of the urgent requirements before us if we wish to maintain a modern navy.

But our deficiency lies not only in the way of capital ships, but also with auxiliaries, matériel, personnel, and docks. It would be a grave mistake to attempt to strengthen ourselves with additional battleships without adequately providing for the requisites that each additional capital ship makes indispensable.

The following are the proportions of the various units needed for a complete fighting fleet: to eight battleships there should be 32 destroyers, 16 submarines, 1 ammunition ship, 2 destroyer tenders, 4 fuel ships, 1 hospital ship, 1 repair ship, 2 submarine tenders, 1 supply ship, and 1 transport. No definite number of hydroplanes has been agreed to, but the board has recommended at various times that no limitation be placed on the number of airplanes to be built each year until the sufficient number for the existing fleet has been reached.

It is very true that ship for ship and man for man our Navy is the equal to any other navy in the world. But it is none the less true that we are not discussing the relative merits of naval units or of individuals that constitute the personnel of the world's navies. We are discussing the Navy, which means the total number of available battlecraft and personnel and, inferentially, all that goes to make up the naval establishment of a great power.

Proceeding from this point, there exists a deficiency in our Navy, as a whole, which ought to be remedied as soon as possible. In order to arrive at a better understanding, the following chart will show what the deficiency is. For the purpose of the comparison ships under construction or authorized will be considered as though available.

| Type | Number of ships available | Under construction or authorized | Total | Number necessary on basis of 42 battleships | Deficiency |
|---|---|---|---|---|---|
| Dreadnoughts | 8 | 7 | .. | ... | ... |
| (Pre-dreadnought) ships[1] | 27 | .. | 42 | .. | .. |
| Battlecruisers | .. | .. | .. | 10 | 10 |
| Arm'd cruisers[2] | 10 | .. | 10 | .. | .. |
| Scouts | 3 | .. | 3 | 42 | 39 |
| Destroyers | 50 | 18 | 68 | 164 | 96 |
| Tenders | 6 | 3 | 9 | 20 | 11 |
| Repair ships | 1 | .. | 1 | 5 | 4 |
| Supply ships | 4 | 1 | 5 | 5 | .. |
| Hospital ships | 2 | .. | 2 | 5 | 3 |
| Ammun'on ships | .. | .. | .. | 5 | 5 |
| Fuel ships | 22 | 2 | 24 | 24 | .. |
| Submarines | 30 | 28 | 58 | 88 | 30 |
| Transports | 5 | 1 | 6 | 5 | .. |
| Totals | 168 | 60 | 228 | 373 | 198 |

[1]Includes old-type battleships.
[2]Armored cruisers have been superseded by battle cruisers; those on hand would be employed as scouts.

The deficiency existing July 1st, 1914, including as it did the building programme of 1914-1915, is the deficiency that exists to-day. As the estimates submitted by the Navy Department for 1915-1916 provide, besides two dreadnoughts, for 6 destroyers, eight or more submarines, one gunboat and one oil-ship, it will be readily seen that the deficiency of about 200 auxiliaries will remain with us for some time.

The foregoing table is based upon a fleet of 42 battleships, which includes the "Iowa." The "Iowa" will be twenty years old next year and must be substituted with a new and modern warship. The "Kearsarge," "Kentucky," and "Alabama" will also reach their age limit within two years, and their tonnage must be replaced.

It is obvious that the programme of two battleships a year will not, for the next few years at least, provide an increase in our Navy, but merely for its modernization. The ships retired can no longer be computed in effective tonnage statistics. A three-battleship-a-year programme would permit an actual increase in effective battleship strength, but certainly not to the proportions recommended by the General Board nor by 1920.

The United States has no battle-cruisers. To neglect them further would mean a deliberate weakening of our naval strength, because such vessels have a military value not possible to obtain from other types or combinations of types. The policy of four destroyers for each battleship was advocated by the board in 1907 and consistently adhered to since then. The ratio is considered essential to a proper balance of the fleet, while tenders in the proportions of 1 to 16 destroyers have become indispensable fleet auxiliaries. The United States has now only one makeshift vessel for ammunition carrying purposes, and therefore the construction of standard ammunition vessels cannot be delayed with safety, and five of them are required. We possess an insufficient number of gunboats to perform effectively the service required for the protection of American interests in Central American and West Indian waters, as well as in the Far East. The present war has demonstrated beyond all doubts that the gunboat is invaluable for coast work, and the British have effectively used these ships along the Belgian coast. Additional sea-going tugs would be invaluable, and they should be furnished on the basis of one tug to every four battleships.

Inasmuch as there is no limit to the number of submarines that may be built in any one year, it is to be hoped that our shortage of 30 will be remedied in due time. The submarine is a most effective defensive weapon, and Germany has used it with remarkable success as a weapon of offense. In this line it offers great possibilities for development. But submarines will not, at the present time, decide any naval war. The ultimate test of strength is the total number of battleships of the first line. To-day, in number of submarines, the United States Navy stands third.

## First Aid for the Cigar

BEFORE a man lights a cigar he always has to cut or bite off the end in order that the cigar will draw well. Even then the cigar occasionally does not smoke as it should. To remedy these defects a certain cigar maker cuts off the end of the cigars which he manufactures and inserts a large pin about two inches in length and provided with a head similar to the tip of the cigar which was removed. The pin is the same color as the cigar and in no respect detracts from the appearance of the article. In fact, the casual observer would not notice it. As a first aid to improve the smoking qualities of the cigar it is highly efficient. The consumer merely pulls the pin from the end of the cigar and then enjoys a perfect smoke. He doesn't have to bite off the cigar end and he doesn't have to fuss with the cigar to get it to smoke evenly and to draw well. This handy scheme has delighted all smokers who have tried it.

## The Current Supplement

A MOST valuable article in the current issue of the Scientific American Supplement, No. 2049, for April 10th, 1915, is "The Life Study of Patients," which points out the desirability of knowing something of the previous pathological history of the patients in order to understand the real causes of the ailment to be treated, instead of acting on the temporary symptoms. The important paper on the Influence of Radio-Active Earth on Plant Growth is concluded. Saving Sunken Submarines is a timely account of the provisions that have been made by foreign countries for the salvage of these craft in case of accident and the rescue of their crews. The account of the industrial development of the United States as told in the Record of Achievement is concluded. There is an interesting technical history of the Liberty Bell, in Independence Hall, in Philadelphia. The new aircraft that cost Lincoln Beachey his life is described and illustrated. There is a valuable article on Gyrostats and Their Lessons. What Everyone Should Know About Cancer sounds a timely warning in regard to this widespread and dangerous disease, and conveys most useful information to the lay reader. The advice on the Use and Care of a Watch will interest everybody. Of interest to the general reader are the notes on Eugenics and War. The note on Color Sensitized Plates will add to the photographer's knowledge.

## Back Numbers of the Scientific American Supplement

WE beg to advise our readers that we have discontinued selling numbers of the Scientific American Supplement dated earlier than January 1, 1914. We removed the first week in April to the Woolworth Building, New York city, and the change in our offices precluded the carrying of issues of the Supplement extending over a period of nearly forty years. It was, therefore, necessary to turn over this portion of the business to someone who has space for carrying so large a stock. The H. W. Wilson Company of 39 Mamaroneck Avenue, White Plains, N. Y., have been chosen to take care of our back number business. They have the complete stock and are ready to supply any of the back numbers at the standard price of 10 cents. We, therefore, request that, in future, all orders for Supplements be sent direct to the H. W. Wilson Company instead of Munn & Co. Please do not order Supplements on letters ordering subscriptions for the Scientific American or the Scientific American Supplement or books, or containing any other matters.

# An Important Development in Color Photography

## The Kodachrome Process of Color Portraiture

IN addition to one or two processes which are only of laboratory interest, all methods of color photography consist of applications of the three-color theory of vision, depending on the fact that any color can be matched by a combination in the proper proportions of the three primary colors—red, green, and blue-violet. There are two main methods by which the combination of these colors can be achieved and a color picture produces, these being termed, respectively, the additive and subtractive methods.

The original process used by Clerk Maxwell in his famous lecture at the Royal Institution in 1861 was an additive process, for he projected on a screen three lantern slides made from three negatives taken of a colored ribbon by means of three lanterns in front of which were glass troughs, these containing, respectively, sulphocyanide of iron, which is red, chloride of copper, which is green; and ammonio-copper sulphate, which is blue-violet in color. The three negatives from which the lantern slides were made had already been taken through the same three solutions. The lantern slide taken by red light was projected by red light, that from the negative taken by green light was projected by green light, and that taken by blue light was projected by blue light, the three pictures being superposed on one another, so that a colored image was seen on the screen, of which the report says: "If the red and green images had been as fully photographed as the blue, it would have been a truly colored image of the ribbon." This imperfection of Maxwell's result was undoubtedly due to his lack of photographic material appreciably sensitive to any colors other than blue-violet.

Since this first experiment the additive process of three-color projection has been used by many workers, the best known being Ives in his famous "Kromskop," which he modified so that the principle could be used both for projection on a screen and also as a view instrument to be used by an individual observer.

One of the latest applications has been the Gaumont three-color process, where three kinematograph pictures are taken on film of the usual width, one over the other, through three lenses, the pictures being somewhat reduced in height so that the three pictures are two and a quarter times the length of the ordinary black and white picture, the film being moved after each exposure through the length of the three pictures. Projection is accomplished by means of a very ingenious triple lens, each positive being projected through its own lens system and filter, and registration effected by moving two of the lenses.

An entirely different application of the additive process of color photography is found in the screen plates, of which the best known example is the Lumière autochrome plate. The possibility of this method was first indicated by Ducos du Hauron in 1869, in the little booklet entitled "La Photographie des Couleurs," in which he outlined many of the processes of color photography which have since been realized in practice. The principle of the screen plate process is to divide the surface of the plate into a number of microscopic filter units—red, green, and blue-violet—and then to take the picture through these units upon an emulsion from which a positive is made either by reversal or by the ordinary photographic methods, this positive being registered with the screen, so that where the emulsion was blackened by exposure through one of the filter units, light is transmitted through that unit in the finished picture. Suppose, for example, that a red object is photographed on a screen plate. Then, where the image of the red object falls, light will pass through the red filter units and will affect the emulsion beneath so that it will be blackened after development, while where the emulsion was protected from the red light by the green and blue units which absorb it, no effect will be produced. Now, if the developed negative be converted into a positive, the portions of it under the red filter units will be transparent, while those under the green and blue filter units will be opaque, so that in viewing the picture the red object will be represented only by the red filter units, the other units being blocked out, and will consequently appear red. The Lumière plate represents this process in its simplest form, the filter screen being coated upon glass and the emulsion on top of the screen, while the negative itself is reversed and converted into a positive, so that it remains always registered with regard to the screen.

These additive processes of color photography, however, have some disadvantages. The projection system, while admirable for the illustration of lectures, is inconvenient for any other purpose, while the screen plates by virtue of the presence of the filter screen are necessarily dark, and the introduction of the filter screen introduces limitations as to definition and quality which are not altogether desirable, so that the subtractive processes, although on the whole they are more difficult to work than the additive, have always been considered as offering many attractions.

The subtractive processes depend upon the generation of colors by the superposition of the three complementary colors—blue-green, magenta, and yellow. Where magenta is superposed by yellow, we get primary red, the yellow absorbing the blue and the magenta the green light, so that only the red constituent of white light is left. Where blue-green is superposed upon yellow we get green, the blue constituent being absorbed by the yellow and the red by the blue-green, and where magenta is superposed upon blue-green we get blue-violet, the red being absorbed by the blue-green and the green by the magenta. Consequently, by superposing the three in the requisite proportions, all colors can be reproduced. The method adopted in practice is to make three negatives through the three color filters just as in the additive process, and then to print positives from these negatives in such a way that the image consists of a colored dye, the commonest method being to print the negatives in bichromated gelatine. Gelatine containing bichromate and exposed to light becomes insoluble in hot water where the light has acted upon it. Consequently, if a piece of paper coated with gelatine containing bichromate is exposed under a negative and then the film of gelatine is transferred onto another piece of paper or a piece of glass and the back of it washed with hot water, the gelatine will be left in its full thickness where the light has acted strongly and has penetrated right through to the back of the film. Where the light has not penetrated completely through the film, the gelatine will be washed away so that its thickness will be in proportion to the extent of the light penetration; that is, it will be a complete positive printed from the negative. This film of clear gelatine will, of course, be almost invisible when dried, but by immersing it in a dye solution, the dye will take in the proportion to the amount of gelatine, and a color positive will result. The three negatives are printed by this process, the negative taken through the red filter being printed on gelatine which is dyed blue-green, the one through the green filter on gelatine dyed magenta, and the one through the blue filter on gelatine that is dyed yellow. When the three colored transparencies are cemented together on the top of one another, the result completely reproduces the colors of the original object. This transparency may be viewed in the hand or examined in front of an artificial light or projected in a lantern, or instead of this, a paper print may be made by stripping off the three gelatine reliefs on paper; and some very beautiful results have been obtained in this way. The only objection to this process is that it is not at all easy to work. The making of the three negatives itself offers no difficulties, but the printing and dyeing of the gelatine reliefs, so as to get them printed alike and developed to the same extent, has made the process too intricate to be a commercial success.

Obviously, one step in simplification would be the substitution of two colors for three. This has already been done in the Kinemacolor additive process of color kinematography, where two negatives are used—a red and a green—and positives from these are projected alternately upon the screen, through red and green filters. The color rendering in this process is quite pleasing, although the correctness is much inferior to that of the three-color process, but the results obtained are sufficiently encouraging to justify the belief that a slight improvement in color rendering over the results obtained by this two-color additive process would be quite satisfactory for many purposes. Now, an investigation of the colors produced by the addition by superposition in projection of two nearly complementary colors has shown that a serious limitation to the range of color which can be produced is imposed by the necessity that the two colors used in the additive process should be nearly complementary to one another, because the whites are produced by the two colors together in full strength, and unless they are nearly complementary, pure whites will not be obtained. On the other hand, in a two-color subtractive process the whites are obtained by the absence of either of the colors, while in the case of full black, the colors would be of such strength that almost any color would be satisfactory. Colors can consequently be used which are not exactly complementary, and under these conditions a very much better range of colors can be obtained than is possible with the additive process, so that a two-color subtractive process should theoretically give a color rendering which, while not so good as the three-color process, should be better than the two-color additive process, and would probably be sufficiently pleasing for most purposes. Clearly, the simplest possible subtractive process will be one in which the original negatives themselves are directly transformed into color positives; therefore, the simplest possible color process will be one in which two negatives taken under two filters were directly transformed into the partial pictures for the two-color process, the red negative being turned into a green positive and the green negative into a red positive, and the two then superposed face to face to make the completed picture. Such a process would employ no loose films and only the minimum number of glass plates, while there would be no transferring of pictures from one glass to another. The final difficulty of registering also is reduced to a minimum. Moreover, if the original negatives can be actually transformed into a color positive, we may expect to retain in the positives all the gradation in the original negatives. The gradation by this process should consequently be as good as can possibly be obtained. Also, since there is no screen and the high-lights are represented by clear, unstained gelatine, the transparency of the picture should be equal to that of a black and white subject.

It will be noticed, however, that this proposed method of working involved one very big step which had never yet been solved, namely, the direct transformation of a negative in black silver into a positive in which the silver of the negative was represented by clear gelatine and the places that were lightest in the negative by a full strength of any colored dye that might be chosen, the transformation being correct throughout, so that all the gradation of the original negative was reproduced in the resulting positive. It was this specific problem of transforming a silver negative into a dye positive, the working out of which made the new two-color process possible. Although the solution now appears simple, it involved a great deal of experiment, small changes in the procedure having much influence on the result, so that a satisfactory process was only achieved by continual experiments and changes in working.

The method adopted is to make the negatives on specially prepared panchromatic plates and through the correct filters, and then develop them as usual. They are then chemically treated so as to remove the black silver and leave the plate looking just like a colorless sheet of gelatine, showing no sign of an image. When this plate is put into the specially prepared dye bath, the dye goes into the gelatine most easily where the silver was absent in the negative; that is, where there was least light in the original photograph or in the part represented by deep shadows; while in the parts corresponding to the high-lights, where there was much silver in the negative, the dye penetrates more slowly, so that as the dye slowly enters the film, the original negative is transformed into a positive produced in a colored dye. While the one color is made in this way, the companion picture is also dyed in the other color, and the two, when placed together, make the finished picture. The process is thus seen to be simplicity itself, the novel point of it being the method which has been worked out for transforming a black and white negative image into a colored dye positive. Since only two colors are used in the process, it is obvious that all colors cannot be correctly rendered, and the colors for which the process fails are the blues, violets, magentas, and purples. Light blues appear blue-green, and violets, black; magentas appear pink; and purples, dark brownish-red. On the other hand, flesh tints of all kinds, and all shades of red, orange or green, grays and blacks are well rendered. As these are predominant in portraits, the results are very satisfying for this class of work. Many of the pictures appear to show blues very well, but this is because by contrast with greens, blue-greens look blue, and especially by artificial light the eye is accustomed not to expect very much of blues. The failure in color rendering is more obvious by daylight, and because of the importance of greens and blues in most landscapes, the process is not suitable for landscape work. The pictures appear at their best when placed in a special illuminator, giving a much truer color rendering than when viewed by daylight. The results obtained are permanent, the colors being fast both to light and heat.

For the practical work of this process it is necessary to have a powerful light in the studio, and experience has shown that the plates can be best worked by the use of artificial light. For this reason a special electric lighting system for working the process has been designed. A camera may be used by which one of the negatives is reversed in position compared with the other, so that when the two plates are put face to face, they will register. Or the pictures may be made in an ordinary camera to which a repeating back has been

*(Concluded on page 350.)*

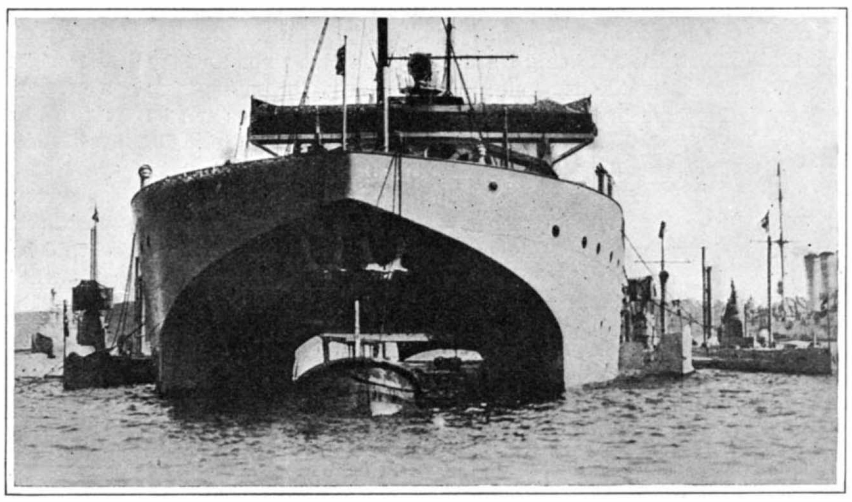
# A Submarine to Salve a Submarine

## How One Underwater Craft Could Aid Another in an Emergency

By Robert G. Skerrett

THE foundering of the "F-4," harrowing as it is, shows how lucky we have been in the past compared with other nations with flotillas of submarines. This catastrophe likewise emphasizes how needful it is that adequate salvage facilities be provided for just such emergencies. Fortunately, this is not a hopeless task, and the object of the present article is to call attention to one of the most promising of these life-saving equipments and, withal, one of the simplest.

The men responsible for the invention, Messrs. Sloan Dannenhower and W. W. Wotherspoon, have had between them years of familiarity with submarine service and notable salvage operations. Their aim is to rescue the men imprisoned in sunken submarines, and, as they put it, "if life is present in a disabled submarine, that life can be saved and saved quickly, in any weather short of a gale, by means of our equipment. The apparatus is simple, light, compact, and instantly available. It consists of a combination of devices which separately have been in successful use in submarines of various types for years. In addition to these, other devices have been invented and supplied, which render the combination capable of easy and sure operation."



The German salvage vessel "Vulkan." Can lift 500 tons 80 feet in an hour.

In short, the object is to make the position of the sunken craft known to vessels on the surface, to facilitate immediate life-protecting aid, and then to provide means by which the damaged craft can be salved through the agency of another submarine equipped with similar apparatus. Essentially, the outfit consists of a detachable marker buoy provided with an air hose connection to the sunken boat and means for coupling that line with the air service of another submarine at the surface, the buoy carrying also an electric signal light and a telephone installation by which communication can be established with the foundered vessel.

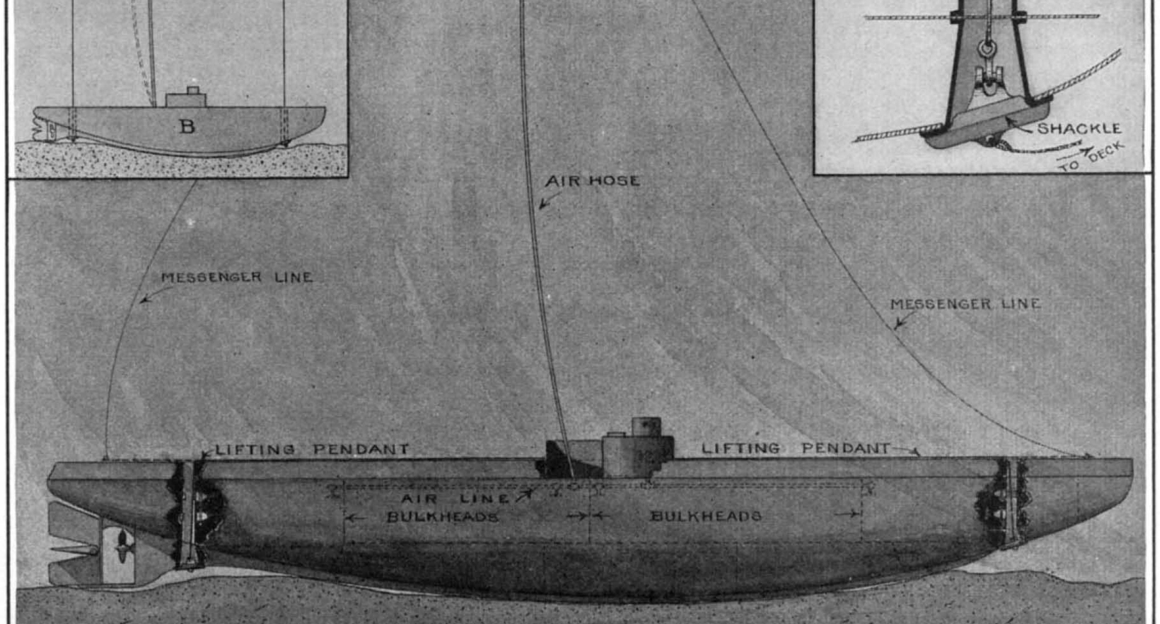
In rising to the surface, the marker buoy carries with it two messenger lines of light bronze cable, which, in turn, are secured to the heavy lifting pendants which are equal to sustaining the load represented by the sunken submarine. These lifting pendants would average 125 feet long with eyes at their upper ends and detachable shackles and pads at their lower ends. The salving submarine would have a like installation, and the method of operation for the relieving craft would be as follows:

The rescuing boat would lift the buoy aboard and open telephonic communication by means of the telephone, *T*, in the central drawing, and, if necessary, would force down compressed air through the hose. Having anchored at a suitable point immediately above the injured submarine, the relief boat would loosen her own lifting pendants and drop them down through the salvage walls and draw the pads on deck over the side. The forward and after messenger lines would then be secured to the shackles, with the pads removed and pulled up through the salvage wells and properly attached to buoys, *D, D*.

Suppose the sunken submarine is 250 feet down, her deck 15 feet above the bottom, and her lifting pendants capable of reaching upward thus to within 110 feet of the surface. These pendants would be held vertically taut by the messenger lines. A diver could easily descend on a suitably constructed, weighted boatswain's chair 110 feet, and there join the pendants of the foundered vessel with those of the salvage submarine at the points *C, C*. Then, the rescuing boat would take in water ballast until she was just awash, and her cable clamps, operated from within the submarine, would grip the lifting pendants. By blowing out this water ballast and rising to the surface she would know that the injured boat was lifted free of the bottom. Finding that the damaged craft could thus be raised, the relief submarine would give herself negative buoyancy of a few pounds and sink gently down on the guiding lifting pendants until she was 100 feet below the surface. Again, gripping the pendants by means of the cable clamps and once more expelling her water ballast, the salvage boat would rise to the surface and lift to that extent the damaged submarine lying beneath her. The rescuing submarine, under her own power, could carry her load to shallower water, where she would repeat the first operation and gradually get her injured sister into moderate depths, permitting the escape of her imprisoned crew through the medium of the usual facilities provided for the purpose. possibly the wounded submarine then, by means of compressed air, could be raised to the surface.

To this latter end, the air line is extended to embrace every separate compartment with individual valves in each one of these spaces. By a suitable arrangement, when more moderate depths are reached, this air could be set free so as to drive out any invading water to the level of the upper edge of the injury admitting it. Before this, however, the relief air would be designed to sustain life only and would not be of a pressure corresponding to the hydrostatic pressure without. Should the messenger lines not be long enough to permit the marker buoy to reach the surface, still that buoy could be swept for carefully just as mines lying below the surface are now detected. Once found, the messenger lines could be secured to others lowered for the purpose. By following the latter down, provided the depth was not too great, a diver could reach the lifting pendants of the injured boat and join with them suitable salvage cables. The main point is that submarines to-day generally practice in groups just as they would be expected to operate in time of war, so that vessels of this sort provided with the installation here described would, without delay, be able to help one another if anything went wrong. The prime necessity is immediate assistance, for otherwise life might be sacrificed.

It was long ago realized by foreign nations that, notwithstanding the rapid and remarkable improvement that was constantly being made in the construction of submarines, accidents of just the kind that has happened to our "F-4" were certain to occur, and they began to make provision against these emergencies. One of our illustrations shows the "Vulkan," the specially designed vessel that was built by Germany a number of years ago, and which has demonstrated its value and utility in actual salvage operations. France soon followed Germany's example and built a still more powerful ship that is capable of lifting 1,000 tons from a considerable depth, while England and Italy made plans in the same direction. The vessels built by France and Germany have double hulls, after the catamaran style, so that the salvaged craft can be pulled up between them by means of strong tackles lowered directly downward, and operated by powerful winches carried on the framework that joins the two hulls. Both of these vessels are self-propelled, but the German boat has a tunnel that extends its whole length, while in the French design the twin hulls merge into a single bow, making a more seaworthy construction. In one of the German submarine accidents twenty-seven of the crew were passed out through the torpedo tubes, and rising to the surface were rescued. No incident of the kind is noted in the Honolulu disaster.




*A*, salving submarine; *A'*, lifting position; *B*, sunken submarine; *C C*, lifting pendants connected; *D D*, wrecking buoys; *E*, air hose; *F*, marker buoy on salving submarine. CENTRAL DRAWING—*T*, telephone connection; *L*, electric signal light. Lifting pendants lying on deck, but attached to messenger lines by the Dannenhower-Wotherspoon method.

**Salving submarines.**

---

**Precautions Against Plague at Hongkong,** according to a report from the American Consul-General at that place, represent a heavy item of expense in the trade of the port, which is ultimately borne by the American or other foreign consumer. All goods likely to carry the disease are disinfected before being offered for shipment, and all vessels carrying them are disinfected at least once every six months. An especially difficult problem is the disinfection and control of the lighters which are necessary for loading goods in the harbor. The number of plague cases registered in Hongkong last year was 2,148, but as 2,024 deaths from this disease were reported, the number of cases was doubtless much larger than the number registered.

As the orchestra played, lights of changing hue illumined the screen.

# Color Music—A New Art Created With the Aid of Science

## The Color Organ Used in Scriabine's Symphony "Prometheus"

By Harry Chapin Plummer

NEW YORK concert-goers, on Saturday evening, March 20, witnessed a novel departure from the conventional symphonic programme when the Russian Symphony Orchestra presented the tone-poem "Prometheus," of the Russian composer Alexander Scriabine, with the employment for the first time, as an "orchestral unit," of an instrument for producing colors, designated by the composer the "tastiera per luce" or "clavier lumière" (color-light keyboard).

The colors appeared, simultaneously with the rendition of the music, filtering through a mesh of fine gauze within a square framework at the back of the stage, above the orchestra, and were controlled from a keyboard, not unlike that of an ordinary piano. The player, or operator, sat at the keyboard in the body of the orchestra and, of course, facing the conductor. He was so located that he saw both conductor and screens. He followed the conductor's beat and the "music," which in appearance differed little from that of the "orchestral voices." As in the conductor's score, which had the part for the "tastiera per luce" at the top of the page in the position usually accorded the part for the first violins, the "music" for the color-light keyboard expressed the color requirements not in color terms, as "red" or "blue" or "green," but in musical notations, as "C," "F-sharp," "A," etc.

An arbitrary color-scale was employed by the composer of "Prometheus," corresponding with a musical scale upon which the tone-poem was built and which is equally arbitrary in the "new" tonal standards which it imposes. His tone-scale, with its color equivalents, follows:

| | |
|---|---|
| C | Red |
| D | Yellow |
| E | Pearly Blue |
| F-sharp | Blue |
| A | Green |
| B-flat | Steely Gray |

Harmonic combinations of these tones naturally demanded corresponding combinations of the various hues in the mesh upon which the gaze of the audience was centered, and, so, many variations of the primary hues and many tints were effected. With the drift of the music, the colors changed and dissolved by superposition, by juxtaposition and otherwise.

It is here that the peculiar nature of the composition which was the medium for the experiment should be pointed out. "Prometheus" is styled by Scriabine the embodiment of the creative energy of the universe—the creative principle of light, heat, life, energy, conflict, and physical and mental activity. Musically, it is what is known as a "programmatic" work, in that it affects to suggest more or less definite subject matter. It belongs in the category of what a sister art would term "futurist" music, principally because of the arbitrary tonal scale established and the striving of the author after a sequence of dissonance and cacophony, rather than the more absolute harmonies of earlier and "orthodox" composers.

In marked contrast to the complexity of the tonal scheme, the color scheme, as finally evolved, proved to be somewhat simple in its operation and in its results. The disadvantage of a fixed location for the colors was quickly discerned, as the illusionary and mystic effect so much to be desired in such a case was lacking.

The splendid resources of the Electrical Testing Laboratories of New York were placed at the disposal of Jacob Altschuler, conductor of the Russian Symphony Orchestra, for the preparations for the music-and-light concert. Preston S. Millar, general manager and secretary of the Laboratories, and past president of the Illuminating Engineering Society, personally supervised the building and installation of the apparatus, and he was assisted in the planning and construction by W. F. Little and in the production of color filters by William McKay, and others of the Laboratories staff.

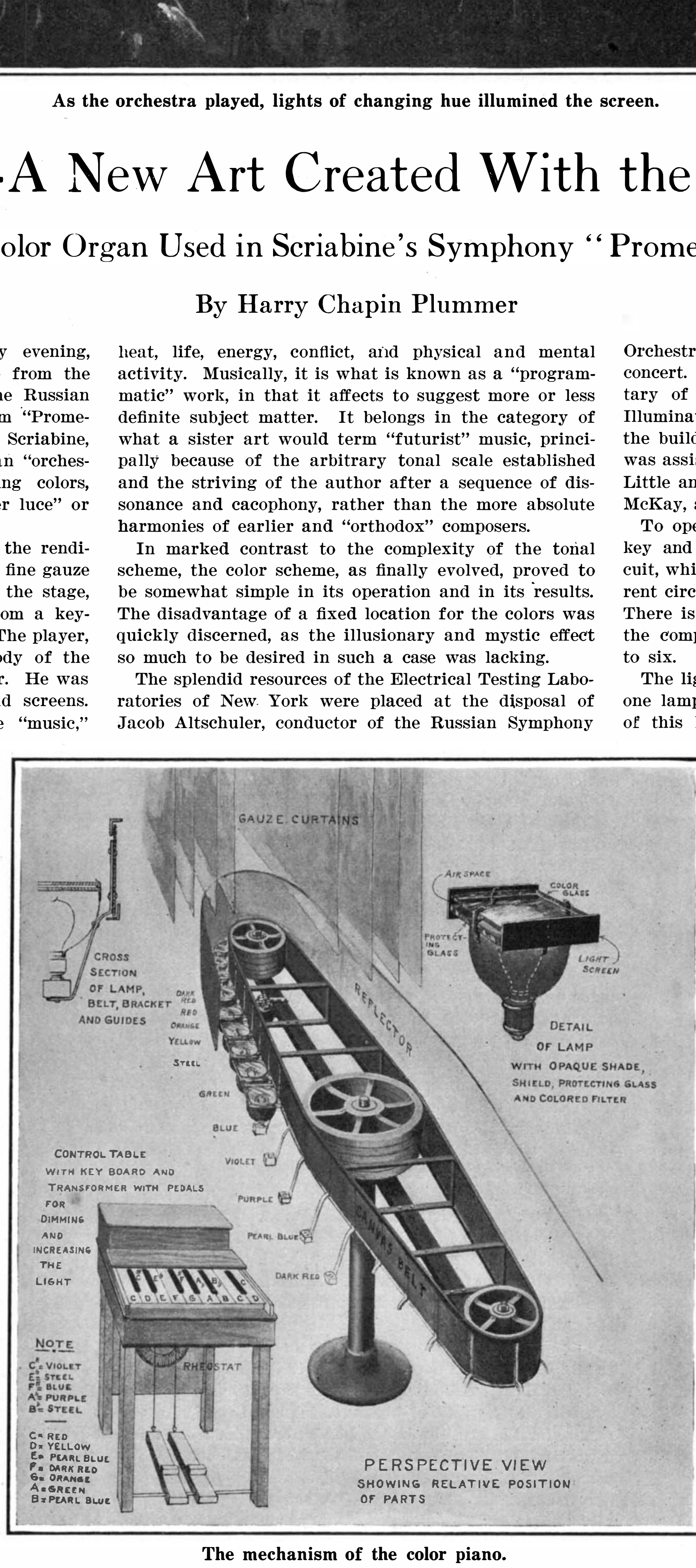
To operate the color apparatus the player presses a key and that makes contact in the direct-current circuit, which actuates a relay, closing the alternating current circuit on the lamp or lamps, which are connected. There is one relay for each hue of light called for by the composer; the number of lamps varies from one to six.

The light of tungsten lamps is so largely yellow that one lamp suffices to produce the yellow hue, but little of this light having to be suppressed. On the other hand, when deep red or violet light is desired, it is necessary to suppress a large part of the light, leaving so little of the desired hue that a number of these lamps is necessary to give the requisite intensity. The lamps range in size from 100-watt vacuum tungsten to 400-watt gas-filled tungsten, and all were specially made for this purpose in unusually small bulbs, and supplied by courtesy of the General Electric Company.

The required regulation of the lamps to vary the intensity of the hues is obtained by employing the reactance in the common circuit feeding all of the lamps. This is operated by pedals, just as intensity of sound is controlled in a pianoforte or organ, the reactance being mounted directly beneath the keyboard and directly connected with the pedals. Whereas, in a piano the hammer is brought into immediate contact with the string, in this instrument the hammer is replaced by a carbon contact; depression of the key brings this contact into abrupt connection with a corresponding fixed contact, closing the circuit and actuating the relay.

Each lamp is inclosed in an opaque concentrating reflector, which gathers a large part of the light and projects it upward and over the mouth of which are placed color filters. These consist usually of three or four glass plates. The first is of crystal glass and is separated by about three eighths inch from the others for ventilation purposes, it being obvious that a great amount of heat is generated and

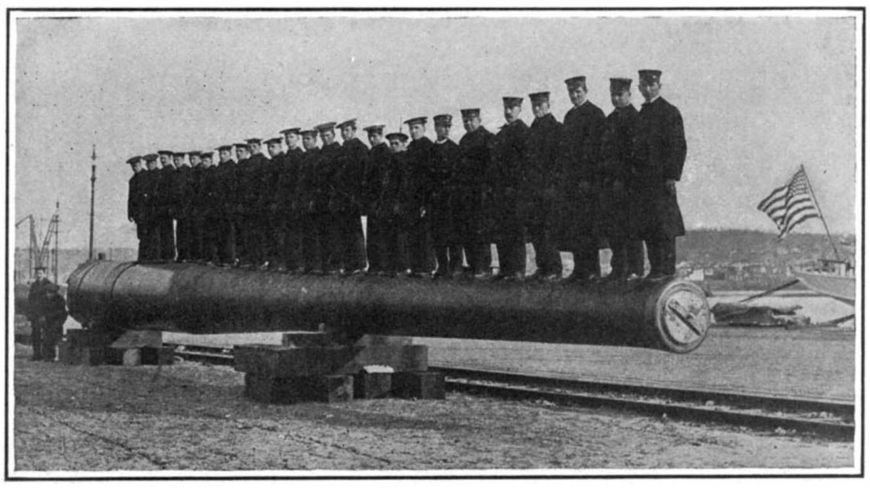
(Concluded on page 350.)




The mechanism of the color piano.

## The 14-inch Guns of the United States Navy

THE accompanying photograph shows one of the 14-inch guns of the new dreadnought "Pennsylvania." In order to give some conception of the size of this gun, twenty-four members of the crew of the President's yacht "Mayflower" lined up on the gun to have their photographs taken with the big engine of destruction. This gun was built at the Washington Navy Yard. It has a total length of 54 feet, and weighs 63.3 tons. It throws a shell of 1,400 pounds weight to an extreme distance of 21,000 yards, in other words about twelve miles. This range could be increased materially did the ship mountings allow for a greater angle of elevation. To be sure the gun is entirely outclassed by the 15-inch guns of the British navy, which fire a projectile weighing 1,950 pounds with a muzzle velocity of 2,500 foot-seconds, as compared to 2,600 foot-seconds of our 14-inch guns. This gives the British gun, with its higher maximum elevation, an extreme range of about 24,000 yards. At the same time the 14-inch gun is not to be scorned. The powder charge it requires weighs 370 pounds, and at 10,000 yards its shell will penetrate 15.9 inches of Krupp armor.



**One of the big guns of the new dreadnought "Pennsylvania."**

## Joy Riding in the Sky

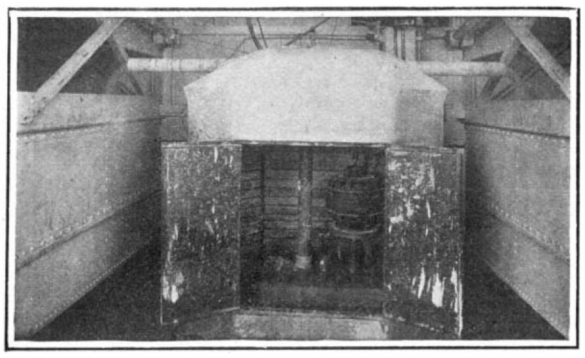
ONE of the prominent features of the "Zone," the amusement section of the Panama-Pacific Exposition, at San Francisco, is a device designed by a Chicago bridge builder which is called an aeroscope, and which will enable sensation seekers to experience some of the pleasures of an aeroplane ride with perfect safety. This contrivance consists really of a bascule bridge 250 feet long, which carries an inclosed passenger car at its free end. While the bridge arm is gradually raised, carrying with it the observation car, the entire apparatus is slowly rotated on a turntable, which results in a gentle spiral course being given to the car, simulating the gliding flight of an aeroplane and giving the passengers views in every direction over the surrounding country.

The entire structure is of steel, and the mechanism is operated by electric power, a heavy concrete platform forming the foundation for the device. On this foundation is a double circular track of railroad rails 61 feet in outside diameter. Eight four-wheel trucks on the rails carry the entire structure, which revolves about a vertical axis set in the center of the platform. Power for this purpose is furnished by four electric motors mounted on, and geared to alternate trucks. Upon the framework supported by the trucks stand two pyramidal towers that carry the trunnions upon which the elevating arm turns when lifting the observation car. This arm is about 215 feet long, while the overhanging counter-balance lever is about 30 feet long, and carries an immense block of concrete, weighing in the neighborhood of 600,000 pounds, which balances the lifting arm, car and its load of passengers so nicely that the only power necessary to raise the car is just sufficient to overcome the friction of the trunnions. Hence two electric motors of eleven horse-power each move the mass.

The observation car is a two-story structure, attached to the lifting arm by trunnions and links so designed as to keep the car vertical no matter in what position the lifting arm may be. The load for which the car is designed is 15,000 pounds, or one hundred people of an average weight of 150 pounds, but there is actually room to accommodate comfortably about 120 passengers, provided they do not exceed the prescribed weight. In order to ascertain this fact quickly and accurately, and also to enable a suitable adjustment of weight to be made when the full number of passengers is not carried, an ingenious construction has been devised. Two ballast tanks are hung below the floor of the car, and when it is in its depressed position these tanks dip into a reservoir of water below the loading platform, and the depth to which they sink constantly weighs and indicates the load. If this load is below the normal an automatic switch is closed, and an electric motor operates a rotary pump to run water into the ballast tanks until the proper balance is attained. If on the other hand the weight indicated is too great, another automatic device opens an escape valve that lets the required weight of water run out of the tanks.

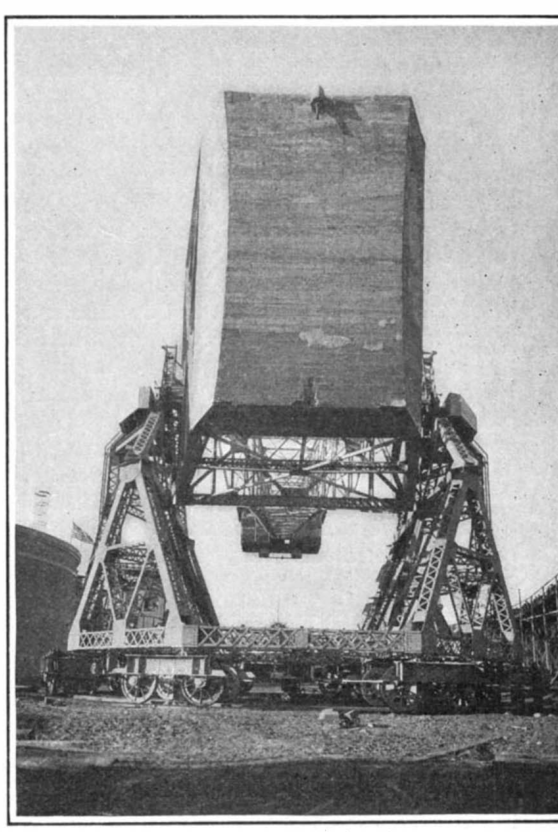
To carry out the idea of flying two electrically driven aeroplane propellers are located on the lifting arm, just under the observation car; but these do not furnish enough power to be of any assistance in lifting, and their effect is purely psychological. They probably mislead the passengers in a harmless way, and as an advertising feature serve to attract attention.

It is impossible to start the lifting or turning motors until the doors have been properly closed and locked. Then the cut-outs are closed, and the operating switches put into connection with the current. First the long arm carrying the car rises vertically, but as soon as it is high enough so that the car will clear the surrounding structures, the motors connected with the turntable trucks start, and the structure begins to revolve. As the arm rises it also swings around. In its ascent the car describes a great spiral. It requires about four minutes to lift the car to its extreme height, and the turntable makes one complete revolution in the same time; and in descending the same operations are repeated. It is possible, however, to vary these movements, for the arm can be stopped before it has reached a vertical position, and then swung around either in complete circles or back and forth through a portion of a revolution, while the passengers enjoy the panoramic view through the plate glass windows which entirely inclose the car.



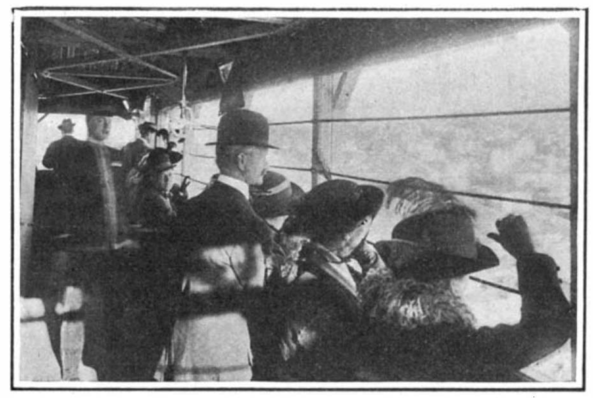
**The passenger car on the aeroscope is provided with two water ballast tanks which provide an even balance for the lifting arm on each trip.**

The weight scheduled to be carried in the car is 15,000 pounds and the filling device adds enough weight in water each trip to make up the scheduled weight. If there is too much ballast, automatic emptying valves permit water to escape to the required amount. The pumping device is shown here filling the tanks.



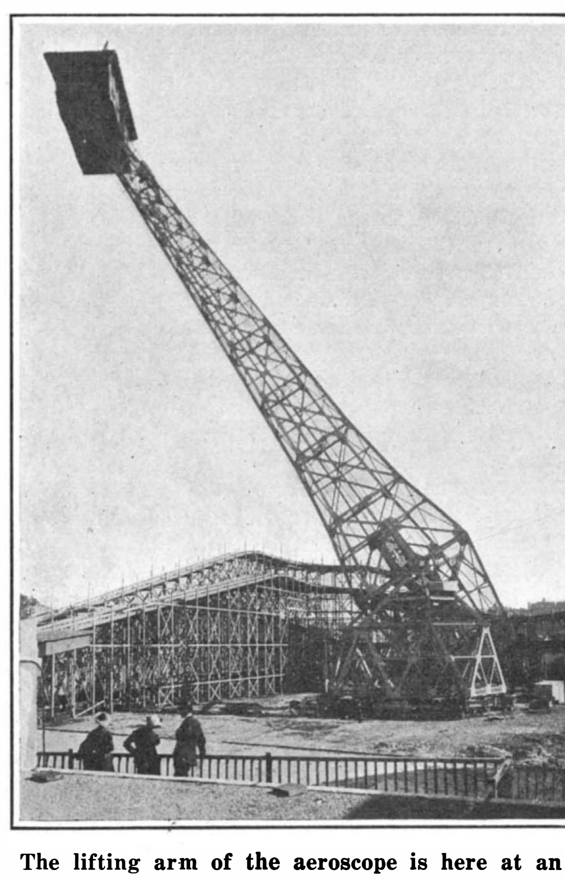
**A view of the towers which support the lifting arm of the aeroscope.**

They are built in two portions to permit the counterbalance weight to swing between as the upper portion of the lighting arm assumes a vertical position. The towers are 49 feet tall and each merges at the top in a trunnion bearing on which the lifting arm pivots.



**Looking out from the passenger car of the aeroscope at a height of 250 feet above ground.**

The capacity of the car is 120 passengers. Plate glass windows are used on all sides so as to give an uninterrupted view. It is possible to look out over the Exposition, the bay and a large portion of San Francisco as the structure is revolved.



**The lifting arm of the aeroscope is here at an angle of about 75 degrees.**

The car is lifted vertically from the landing station until clear of the surrounding structures, then the structure is revolved in a circle. Aeroplane propellers placed on the arm just below the car give an impression of flying.

## Effect of Tarred Roads upon Trees

A PARIS engineer, M. Hickel, gave the following report about the effects of tarring of roads upon trees and shrubs which border the roads. Dust which comes from the wear of the road, when it falls continually upon the leaves of plants, is often seen to cause lesions and burned places, starting from a simple spot and extending farther, even to a perforation of the leaf, according to Griffon and Mirande's observations. Vapors produced at the time of putting on the tar on the road have also a bad effect, though it is less. Damage is seen to depend also on the amount of traffic on the road and, too, upon the sunlight, and this latter favors the production of lesions. Ornamental plants, such as the begonia, are found to suffer much from the tar dust in these cases. Besides the lesions seen in leaves of trees, such leaves do not grow to full size, but are dwarfed, and in general the tree tends to perish. Different varieties of trees suffer less than others, for instance the sycamore is noticed to suffer less damage. Perishing of trees occurs only after several years.

Tarring of roads is usually done because of automobile traffic, and the author recommends the following precautions so as to conciliate the two opposing interests:

Instead of a surface tarring, it is preferable to relay the road with the use of tar combined with the road material, so as to avoid frequent tarring operation and formation of dust. Where plants are found to suffer greatly from the effects of tar, another material should be used instead, and tests are now being carried on which give promise of finding what is needed in the class of bituminous and asphaltic substances. A radical solution would be the use of concrete roads.

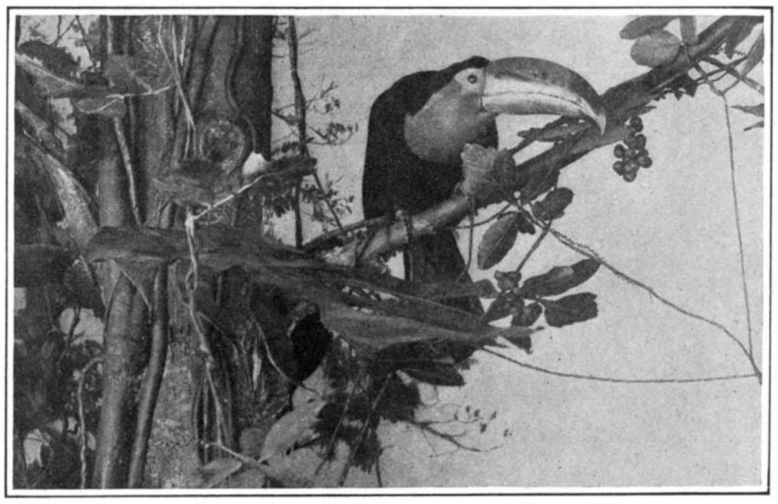
# Two Groups in the American Museum of Natural History

## Wonderfully Realistic Reproductions of Animal Life in Natural Surroundings

By Joseph William Griggs

EVERY resource of science and art is employed at the American Museum of Natural History to reproduce nature faithfully. The stiff, unnatural display of other years has given way to the effective "group" form of exhibition. Of the many groups completed in recent months, two stand out conspicuously—the Wharf Pile Group and the Orizaba Group.

As a reproduction of nature and as an artistic piece of work, the Wharf Pile Group has never been surpassed. It was constructed under the supervision of Roy W. Miner. The handling of color and illumination has been so skillfully done as to produce distance in the scene above water and depth below. The group is based on actual observations by Mr. Miner and his assistants at Woods Holl, Mass., and shows the animal life of the abandoned wharf piles.



A toucan at home; a detail of the Orizaba group in the Museum of Natural History.

A field model had to be made in the nature of a sketch. Living specimens of the creatures of the wharf piles had to be taken to the laboratory and kept alive in sea water. Studies were made of them with and without the microscope; dozens of sketches and photographs were made.

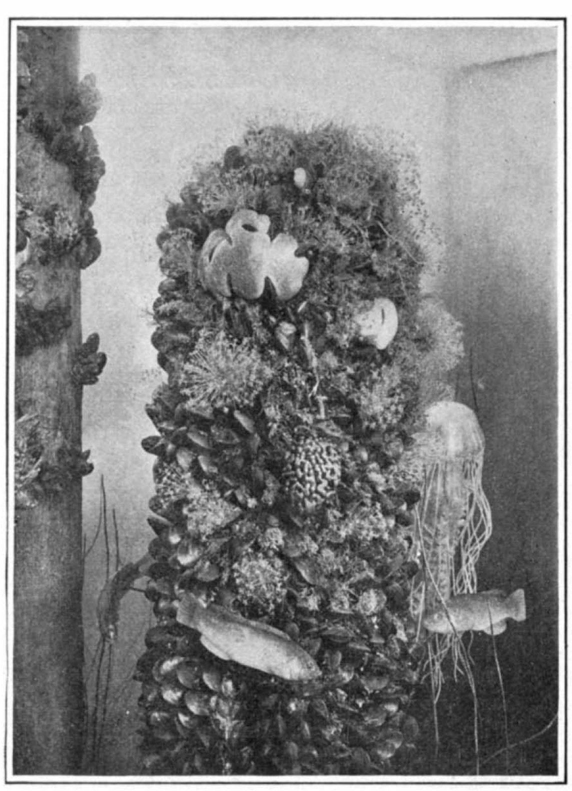
Hundreds of tentacles of the sea anemones, cirri for the serpuloid, and even some of the seaweed, are the work of the glass blower. The finest work in this line are the jellyfish and the squid. The former is considered a masterpiece of the glass blowers' art, while the peculiar translucency of the squid's body could be attained by no other medium. The coloring of these two models was done by a Japanese artist.

Much of the animal life was modeled in wax and celluloid. The accurate reproduction of the wharf piles was the work of Mr. Ignaz Matausch, who also assembled and anchored the hundreds of separate models and specimens in their final positions.

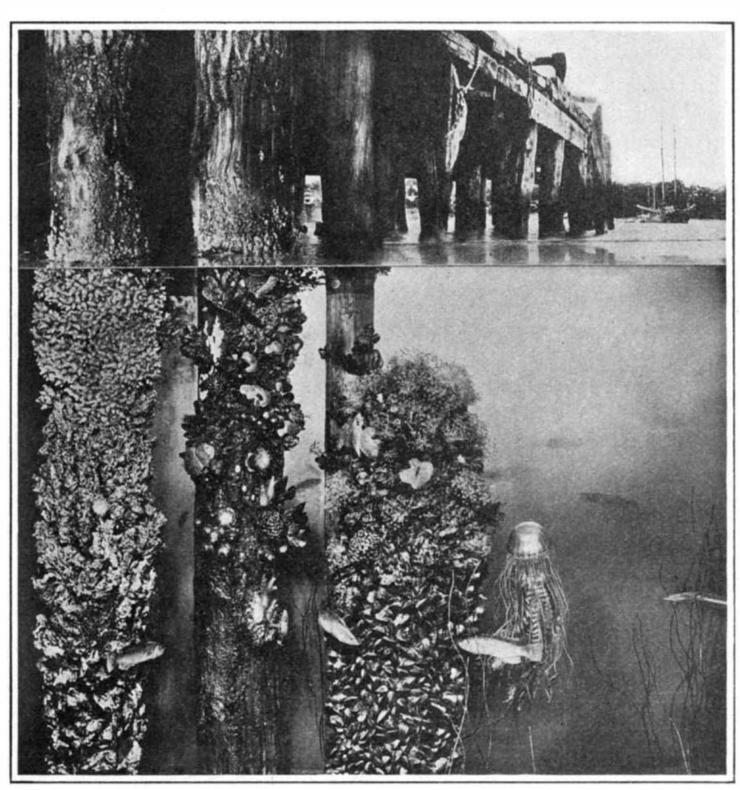
A section of the Orizaba group in the American Museum of Natural History.

The coloring of transparencies proved a difficult problem, involving the application of transparent oil colors, selected for permanency under strong sunlight, to the surface of glass covered with delicate photographic film (in the case of the transparencies represented above the water line), and to the smooth surface of the plate glass for the submarine background. Five successive sheets of glass make up the submarine background, each colored in such a way that the daylight passing through the entire series gives the effect seen when looking horizontally through the waters of the ocean. Actual observation in the sea itself, with the help of a water glass and a submerged mirror, was the basis of the color scheme. Fishes, squid and a distant pile were painted on the successive plates of glass, giving them the lifelike effect of appearing suddenly from the gloom of the green sea depths. The illumination of the group is accomplished by placing it in front of a window.

The Orizaba Group called for a vast amount of work. To one artist was intrusted the painting of Mount Orizaba and a forest in the distance. Birds had to be placed in realistic trees in the foreground by others. As a basis for the whole group actual sketches had to be made in the Mount Orizaba region. This group shows a section of country which is three miles high, and according to Frank M. Chapman, of the museum, to find on a level the changes to be met with here a person would have to journey from Vera Cruz to Maine, a distance of 3,000 miles.



Detail of the wharf-pile group, representing life under water.



Animals of the wharf piles—a remarkable model in the American Museum of Natural History.

The observer sees, apparently, through the upper side of a gorge through which runs the Rio Blanca, the vine-hung tropical forest, the snow-capped Orizaba rearing its head 18,000 feet into the heavens. The foreground shows such birds as the motmots, trogons, parrots, tanagers, and big-beaked toucans. Even humming birds are hovering over orchids. Henry A. Ferguson and Louis Agassiz Fuertes made sketches around Orizaba for the group, and Bruce Horsfall, the painter, executed the background from these sketches. Transparencies at the sides of the group show scenes from different altitudes in the country portrayed in the painted background, from the tropical forest to the cold summit of Mount Orizaba.

### Sounding Operations in the Rhone

IN order to find the depth of alluvion in the Rhone bed at the time of establishing the report upon the proposed barrage near the Swiss frontier, a novel method of sounding was employed. The present barrage is to be built across a narrow and deep portion of the stream, and is intended for the great Rhone-Paris hydro-electric plant. Having installed a pair of pontoons in the river, Engineer M. Lugeon found that the usual method of sounding by the use of boring tubes could not avail here on account of the nature of the current and other conditions, so that this led him to carry out the sounding by the use of rails, and to drive them down through the alluvion to the solid rock. On the pontoons he mounted a pile-driver having about 12 feet drop. The first rail was carefully pointed at the end, and it was driven into the soil by the pile-driver. When down to the water level, a second rail was attached to the end of the first by a special fish-plate, somewhat as for railroad practice; then the second rail was driven down by pounding until they no longer sank. The number of strokes at each point of sounding varied from 1,000 to 4,604, according to the nature of the soil. For the whole of the upstream profile, there were given no less than 18,046 strokes. When the rails went up farther, they were broken off flush with the river bed. Cutting off by dynamite could not be done here, as the explosive had no effect at 12 to 15 feet, so that the rail was broken off flush by repeated bendings. Noting the length of rail sunk in the soil, this gave the thickness of alluvion at each of the several points, so as to obtain the profile of the river.

### Deflecting Rays Downward

THE trouble with glaring headlights on automobiles, which has resulted in many accidents and has been legislated against in some of the States of the Union, is demanding full attention on the part of motorists. There are a number of devices on the market at present which are constructed in a way to diffuse the direct glare of the lights, but there still remains plenty of opportunity for the inventor along these lines. One of the most promising of these devices has just been brought out by a Toledo firm.

The deflector consists of a small metal bowl highly polished on the inside. This bowl is attached to the electric bulb of the headlight and throws all the light rays directly upward into the upper half of the lamp reflector. The stream of light is thereby thrown directly forward on the road, the highest rays not reaching more than four feet above the ground. None of the light rays thus projected reach the eyes of pedestrians or approaching motorists.

The invention, of course, at once suggests the blackening or frosting of the lower half of the headlight reflector, which would give the same effect.

## The Scientific American's New Home

THE first home of the SCIENTIFIC AMERICAN was at No. 11 Spruce Street, in New York city, where it was established in 1845 and published by Rufus Porter, a somewhat erratic genius who filled its columns with many other matters than those its title suggested. On October 20th, 1845, the office was destroyed by fire, and publication was suspended for two issues. When the publication was purchased by the new firm of Munn & Co., composed of Orson D. Munn and Alfred E. Beach, in July, 1846, the office was moved to the old *Sun* building, which then stood at the southwest corner of Fulton and Nassau streets. There the paper prospered for a number of years until the old quarters were found too small, particularly for the patent soliciting department which had been established. New and commodious offices were, therefore, secured in the original New York World Building at No. 37 Park Row, at the corner of Beekman Street, to which location the publication was moved in 1859, and this was its home until January 31st, 1882, when the building was completely destroyed by fire. Practically all the valuable records and papers that had been accumulating for years were lost.

The period from 1859 to 1882 had been one of unusual prosperity for the SCIENTIFIC AMERICAN. It had gained readers in every part of the country and in foreign lands, and had won for itself a reputation as an authority on technical matters. No time was lost in securing temporary quarters, and publication was continued without a break from No. 261 Broadway, at the corner of Warren Street. Here the offices were maintained until 1884. In that year the establishment moved to No. 361 Broadway, at the corner of Franklin Street, where two commodious floors have been occupied until now.

After thirty years at No. 361 Broadway, it was felt that more modern quarters were needed—quarters that harmonize with the character of the SCIENTIFIC AMERICAN and the patent soliciting of Munn & Co. The Woolworth Building, the tallest and most modern structure of its kind in the world, was selected as the new home of the SCIENTIFIC AMERICAN and of Munn & Co. Two wings of a whole floor will now house the staff of the SCIENTIFIC AMERICAN and the Patent Department of Munn & Co. The new home of the SCIENTIFIC AMERICAN and Munn & Co. is not only more commodious than the old, but is so well equipped with conveniences of all kinds that the businesses of publishing an important periodical and soliciting patents can be conducted with even greater efficiency than before.

Copyright by B. G. Mitchell

**The new home of the Scientific American—the Woolworth Building.**

## The "Torpedo" Motorcar

THE remarkably shaped motorcar shown in the accompanying illustration has been built in Italy, it is reported, according to designs evolved by Count Marco Ricotti of Milan. It carries, as will readily be understood, the matter of streamline body design further toward its logical conclusion, although it stops short of the real goal. In this connection it may be interesting to point out here that as long ago as January, 1913, the SCIENTIFIC AMERICAN pictured the "automobile of the future" as a fully inclosed torpedo, in which even the wheels and mudguards disappeared within the "streamline" curve.

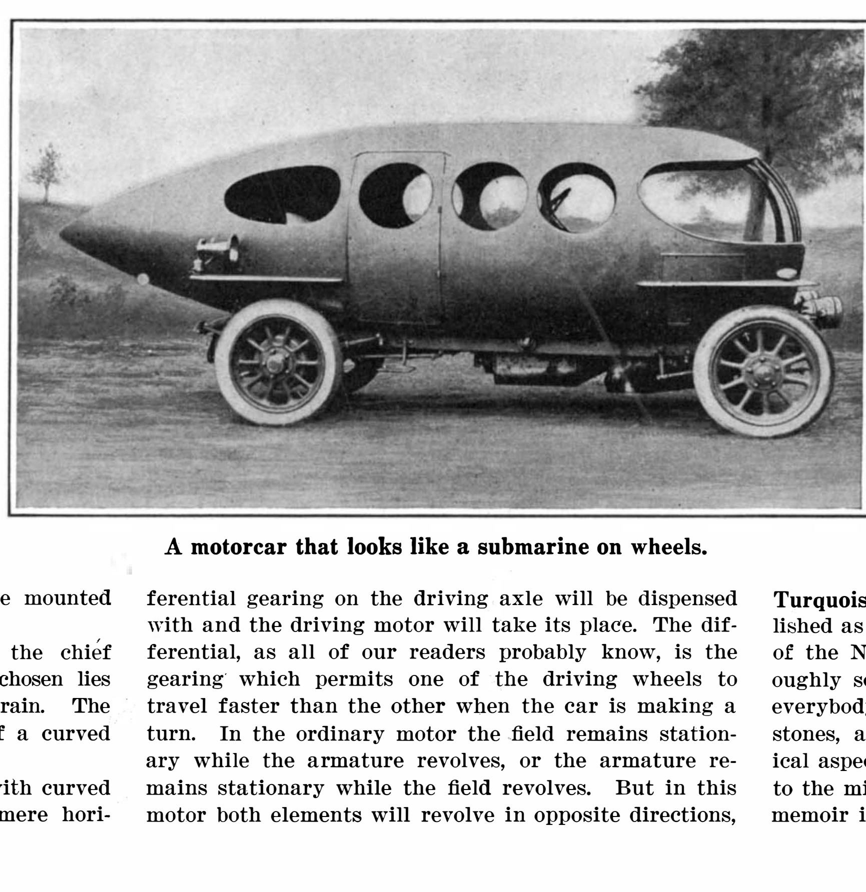
The Ricotti car is fitted with a 50 horse-power four-cylinder motor, which enables this torpedo on wheels to cover ground at the high rate of 80 miles an hour. Removing the streamline body and letting the car go at top speed in "stripped" shape, immediately reduced its speed to 65 miles an hour.

When one considers the considerable weight which such a body has, it must be regarded as a remarkable demonstration of the importance of wind resistance at high speeds. The ordinary touring car, with a maximum speed of some forty-five miles an hour, would probably show an increase of five miles or more, per hour, if a real torpedo body were mounted on its chassis.

Aside from the higher speeds attained, the chief value of a body such as Count Ricotti has chosen lies naturally in the protection from dust and rain. The front of the car can be closed by means of a curved windshield of glass.

In order not to catch the air too forcibly with curved mudguards, the Ricotti car is fitted with mere horizontal strips of sheet iron placed six inches above the tires.

The curiously shaped windows suggest a submarine boat. As a vehicle of distinction, the Ricotti car probably would create a good deal of attention should it run along Broadway, New York, on some bright summer's day, but that the general public would not care to hide behind the narrow windows is hardly to be doubted—for one of the most powerful factors in the evolution of a motorist is the desire to "see and be seen."



**A motorcar that looks like a submarine on wheels.**

## A Lightweight Electric Vehicle

HITHERTO the electric pleasure vehicle has not been a serious competitor of the gasoline car, but has filled a special field of its own. For despite its cheapness of operation, simplicity of control, ruggedness and cleanliness, it has labored under the handicap of a big storage battery that makes the car heavy and expensive, giving only a limited speed and radius.

But a new electric car has just been announced which boldly aims to invade the field of the low priced gasoline car. This it expects to do by a radical simplification of mechanism that will cut down weight, making it possible to use a far lighter battery, and thus reducing the handicap materially. In this new car the differential gearing on the driving axle will be dispensed with and the driving motor will take its place. The differential, as all of our readers probably know, is the gearing which permits one of the driving wheels to travel faster than the other when the car is making a turn. In the ordinary motor the field remains stationary while the armature revolves, or the armature remains stationary while the field revolves. But in this motor both elements will revolve in opposite directions, one element being connected to one half of the driving axle and the other element to the other half. Thus, the power is divided between the two halves of the axle, so that in taking a turn one may readily move faster than the other exactly in proportion to its load. Of course, if the axles were directly connected to the armature and fields, respectively, the two driving wheels would revolve in opposite directions. But a very simple gearing has been introduced, based on a new mechanical movement, comprising one stationary gear, one rotating gear, and a "floating axle." By this means a gear reduction of 6½ to 1 is introduced between the motor and the driving axle, and the motion of one half is reversed with respect to the other half, so that both of the driving wheels turn in the same direction. The entire rear axle with its motor of 2 horse-power weighs under 100 pounds, which is even less than the weight of the common rear axle with its differential.

Of course, it will be understood that, owing to the uniform torque of the electric motor, a much lower power is required than if a gasoline engine were used. One of these rear axles with 2 horse-power motor was installed on a car weighing 1,810 pounds and proved sufficient to drive it at a rate of over twenty miles an hour. But a new car is being built which will have a total weight of only 1,200 pounds, 600 pounds of which will represent the lead battery. With this, no doubt a higher speed will be obtained. Were Edison batteries used they would weigh but 450 pounds. It is planned to reduce the weight of the vehicle even further, making it only 1,000 pounds, in which case it would have a battery of only 500 pounds, the plan being always to let the battery represent half of the total weight of the car. This is a higher proportion than now prevails, for the common practice at present is to let the batteries represent only about 40 per cent of the total weight of the car.

As the car is reduced in weight, its cost is reduced in even greater ratio, and it is fully expected that this car can be manufactured and sold at a price that will compete with low-priced gasoline vehicles. Of course, it will still be handicapped in the matter of high speed and radius of travel, as well as by a scarcity of recharging facilities outside of the big cities, but it is believed that these disadvantages will be far outweighed by its advantages. Any material increase in the use of electric vehicles will naturally be followed by an increase in charging facilities.

As there is no mechanism connected with the motor except that contained in the housing of the rear axle, all the rest of the space ordinarily occupied by motor and gearings can now be used for storage batteries. The motor itself can be run at double the speed of present motors of the same horse-power, because the speed is divided between the two parts of the driving axle. It is designed to run interchangeably as a shunt or a series motor by the mere pressure of a push button. On hills it may be made to act as a brake, and when certain speeds are exceeded it will act as a generator to put back current into the battery, thus greatly economizing the power stored in the battery. Unfortunately, at the present time, we are not permitted to give complete details of the machine, owing to the condition of the patents, but we expect at a later date to take up this subject again and explain more fully this interesting development in the electric vehicle. We can merely hint now that this differential motor might be used on gasoline-driven vehicles. A light gasoline motor running at constant speed and direct connected to a generator would furnish power to the differential motor on the rear axle. This, without adding much, if any, weight to the machine, would provide a very simple control of the vehicle and do away with all the complications of gearing now required. The inventor of this electric vehicle is Mr. Harry E. Dey, who has as his associate in the development of the vehicle, Dr. Charles P. Steinmetz, the electrical engineer of wide renown.

---

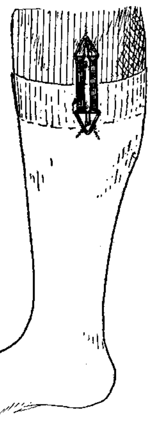
**"An Exhaustive Monograph on the Turquoise,"** by Joseph E. Pogue, has just been published as the third memoir of volume 12, in the *Memoirs* of the National Academy of Sciences. Although thoroughly scientific in character, this treatise appeals to everybody who is interested in the lore of precious stones, as the historical, mythological, and archæological aspects of the subject are fully treated, in addition to the mineralogical, geological, and technological. The memoir includes a large annotated bibliography.

## RECENTLY PATENTED INVENTIONS

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

### Pertaining to Apparel.

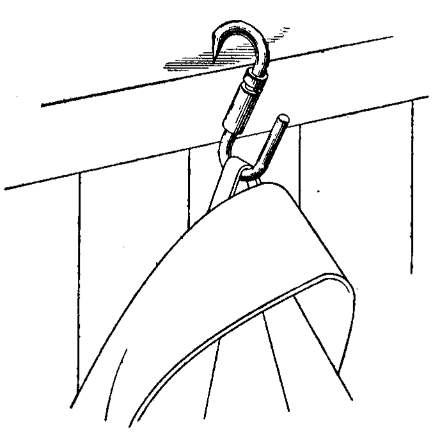
HOSE SUPPORTER.—E. SCUDDER and C. M. CORLEW, 3-4 Southwestern Bldg., Sioux Falls, S. D. This invention is an improvement in hose supporters, and has for its object to provide a supporter arranged to connect the hose to the undergarments without encircling the leg to cause injurious pressure, which may



HOSE SUPPORTER.

be easily detached and detached without any danger of tearing or otherwise injuring the clothing. To release the supporter it is necessary to remove one of the folds from between the gripping jaws and the support may be left in place on either the sock or the underwear.

COAT HOOK.—J. T. WHITE, 61 W. 133rd St., New York, N. Y. The object of the invention is to provide a portable coat hook adapted to be readily extended and attached to a suitable support for supporting a coat or



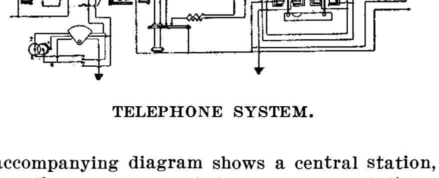
COAT HOOK.

other garment and adapted to be folded into a safety position, to take up very little room with a view to allow of conveniently carrying the coat hook in a pocket.

### Electrical Devices.

TELEGRAPH REPEATER.—F. E. WALLACE, Heddie, Cal. This invention improves and simplifies the construction and operation of telegraph repeaters so as to be more reliable and efficient in use, less expensive to manufacture, install and keep in repair, and so designed that a more rapid transmission of messages is possible without distortion of the dots and dashes, and rendering it possible to repeat through an indefinite number of circuits with practically as good results at the final as at the initial circuit.

TELEPHONE SYSTEM.—H. M. WRIGHT, Cashion, Okla. Mr. Wright's invention has reference to party line telephone systems in which the central station is provided with a selective switch for calling subscribers and for locking out such subscribers as are not called. The



TELEPHONE SYSTEM.

accompanying diagram shows a central station, and the nearest one of the subscribers' stations, this being a part of a lockout system in which the subscribers' stations are not provided with hand controlled selective switches.

SOUND REPRODUCER AND RECORDER.—W. J. TRAVERS, 420 Parkside Ave., Buffalo, N. Y. In this case the invention relates to sound reproducers and records and has reference more particularly to the stylus bar and its armature, in which magnetic means are used for maintaining the stylus bar armature in a predetermined position.

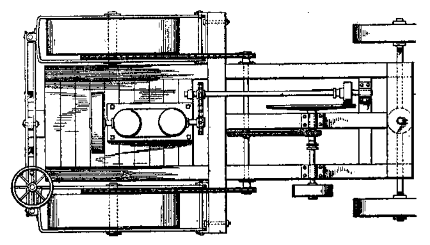
### Pertaining to Aviation.

AUTOMATIC STABILIZING AEROPLANE.—W. HUEBNER and O. KUNKEL, 22 Main St., Garfield, N. J. The operating part constituting the propelling and balancing mechanism, as well as the basket, are supported in a manner to permit the supporting planes to turn at various angles under the influence of air currents, while at the same time increasing the buoyant action of the planes, whereas the basket and working parts referred to will remain normally dependent, and the liability of the operator losing control of the machine or being thrown from his position, will be obviated.

### Of Interest to Farmers.

INSECT DESTROYER.—M. D. BAREFIELD, Hollandale, Miss. In this device a wheel supported frame is provided, upon which is mounted a fan having delivery pipes, spaced apart and laterally and longitudinally of the frame and adapted to move on opposite sides of the row of plants to blow the insects and the like into the furrows at each side of the row and having in addition mechanism for burning the insects after having been blown into the rows, and having other mechanism for spraying the plants with an insecticide.

TRACTOR.—C. W. LOEFFLER, Cedar, Mich. In this instance the invention has reference to tractors, the more particular purpose being to provide a tractor with running gear so arranged that the body or platform of the trac-

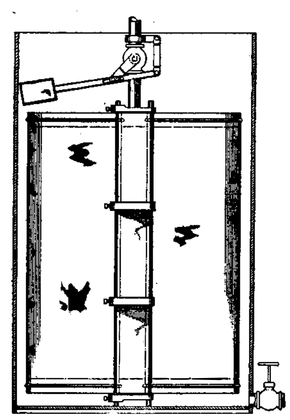


TRACTOR.

tor may be maintained substantially level, while the wheels engage the ground at different levels. The tractor admits of general use, but is of special service in connection with plowing the land.

### Of General Interest.

FILTER.—C. A. YOUNGMAN, 1217 2nd St., Louisville, Ky. This invention relates to the filtration of liquids, particularly to the filtering and clarifying of whiskies, wines, beers, etc., and one of the main objects thereof is to pro-



FILTER.

vide a relatively enormous area of the filtration medium within a relatively small compass. A further object is to provide a rack for supporting the said medium, which permits of ready and easy installation and removal of the medium.

FOLDING BOX.—S. BERGSTEIN, care of Interstate Folding Box Co., Middletown, Ohio. The invention has reference to folding boxes, and the main object thereof is to provide self-contained means for maintaining the members thereof in position when set up for packing articles therein, such as clothing and the like.

PICTURE FRAME.—M. LOEWENTHAL, 1133 Broadway, New York, N. Y. The invention relates more particularly to such frames as are adapted for framing pictorial novelties, such as post-cards, photographs, and fancy prints. It provides a structure which may be bent or shaped to the desired form, said structure being constructed as an elongated article, arranged so that a number may be nested for transportation or storage.

AX DISPLAY STAND.—C. L. SAMUEL, Pryor, Okla. The objects here are to improve and simplify the construction of exhibiting stands, racks or the like, so as to be comparatively inexpensive to manufacture, to take up a minimum of floor space while having a large storing capacity, and at the same time holding the axes in such a manner as to effectively display them.

DISPLAY AND VENDING APPARATUS FOR SPECTACLES.—D. D. SULLIVAN, Fargo, N. D. This apparatus is for use in stores for displaying, selecting and vending spectacles, eyeglasses and similar instruments of vision, and arranged to enable a customer who is without knowledge of optics to readily select the proper instrument of vision. It is for use of opticians for quickly and accurately fitting persons for proper spectacles or eyeglasses.

SAMPLE CARD.—C. GREEN, 78-80 Walker St., New York, N. Y. This invention has reference to improvements in sample display cards, and has for an object to provide a structure wherein the card is properly held in place and a display tag is provided with a number or other identifying designation arranged thereon.

NAPKIN.—E. A. DE ROSE, 51 E. 42nd St., New York, N. Y. This invention refers to napkins for use by women, more especially where such are formed into catamenial sacks, and it provides such devices which are sanitary, odorless in use, readily placed in position and removed, easily cleansed, and which also protect the person and garments of the wearer.

LANTERN SLIDE.—F. A. APFELBAUM, 1560 Broadway, New York, N. Y. This invention provides slides with manually adjusted means for showing the time on the illuminated field of the screen used for exhibiting said slides; provides a means for adjusting the hands used in conjunction with a clock dial for announcing the time periods; and performs the operation of mounting said hands for use in conjunction with the dial in a manner to avoid destruction or damage to the dial or element carrying same.

FIRE LEER.—J. J. DENNING, 3025 South Raymond Ave., Los Angeles, Cal. The improvement pertains to a portable leer or annealing oven for glassware, more particularly intended for tumblers, glass dishes, goblets, and the like. The construction and arrangement of the leer is particularly designed for effectively utilizing the heat of the molten glass for annealing.

### Hardware and Tools.

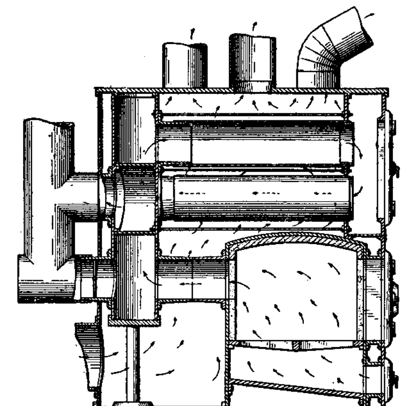
DRILL.—F. R. WEATHERSBY, 312 Scanlan Bldg., Houston, Tex. The invention relates more particularly to drills of the type suitable for earth boring, the more particular purpose being to provide a drill having means for positively centering the drill before the main cutting edges thereof come into play so that the drill will be at all times guided in an accurate straight path.

### Heating and Lighting.

FIRE GRATE.—H. BENTON, 764 Newark Ave., Elizabeth, N. J. This improvement provides a structure adapted to facilitate the removal and renewal of destructible portions; provides for dumping certain portions of the fire-bed; provides for regulating the movement of the fire supporting members of the grate bar, and to provide for installing grates and bars therefor.

DOWNDRAFT SIDE FEED SMOKELESS FURNACE.—M. E. HERBERT, care of Herbert Boiler Co., Root and La Salle Sts., Chicago, Ill. This invention provides means in a side feed furnace for holding the coal at the sides until it is coked by means of water legs, and for then feeding the coked fuel to the center of a water tube grate and between the water legs, and having a lower grate provided for catching and holding the smaller particles, and wherein means is provided for moving the fuel, and also means for constraining the draft to pass down through the burning fuel to consume all of the carbon usually wasted as smoke.

FURNACE.—F. O. MOLL, 449 Baldwin St., Portland, Ore. This furnace is of the "warm-air" type and the object of the inventor is to produce a heater of this nature which will be easily cleaned, proof against leakage through its walls of the gases generated therein, and so



FURNACE.

constructed that the parts thereof can be replaced when any are worn out. It will readily radiate heat, require comparatively little fuel in operation, and be capable of using a lower grade of fuel than is usually required for similar furnaces now on the market.

### Household Utilities.

FLY TRAP.—J. CRAWFORD, P. O. Box 137, El Paso, Tex. In this trap the flies will be readily attracted, and they will find free and ready entrance. The trap is so formed that the trapped flies may be conveniently and readily disposed of, and may be adapted for thorough and convenient cleaning in order to preserve its sanitary condition.

LAVATORY STRIKE.—O. KATZENBERGER, 215 N. Huron St., Chicago, Ill. This invention relates to what are known as strikes, and particularly to lavatory strikes, and has for an object to provide an improved structure which may be readily applied to marble slabs or other supports of various thicknesses without injuring the slab or support, or the strike.

COVER FOR WASHTUBS.—H. GREASON, 108 W. 99th St., New York, N. Y. The purpose of the invention is to provide a new and improved sheet metal cover for wash tubs and the like, which is exceedingly strong and durable and not liable to bend or warp or injure the tub, especially if the latter is made of soap stone or slate.

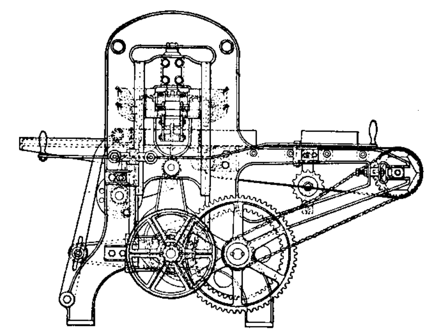
CLOSING DEVICE FOR DOORS.—C. W. STITES, 58 E. 86th St., New York, N. Y. This invention provides a device for closing the space between the hinge side of the door and the jamb whether the door is open or closed, thus preventing persons from peeping through the said space into the room, at the same time rendering the door air and dust proof at this point.

### Machines and Mechanical Devices.

SAW SETTING, FILING, AND SWAGING MACHINE.—O. PAULSON, Box 6, Heber, Utah. This invention improves and simplifies the construction and operation of saw machines of this character so as to be reliable and efficient in use, easily and quickly adjusted and operated and capable of being mounted on the table of the saw machine in co-operative relation with the band saw while the latter is in position.

BREAD SLICING MACHINE.—M. KRONFELD, 67 E. 106th St., New York, N. Y. This invention provides a machine having a base and guard for holding a loaf of bread in substantially definite position, a series of knives and means for actuating of said knives simultaneously in parallel planes so as to reduce the entire loaf or any desired portion thereof in a single operation.

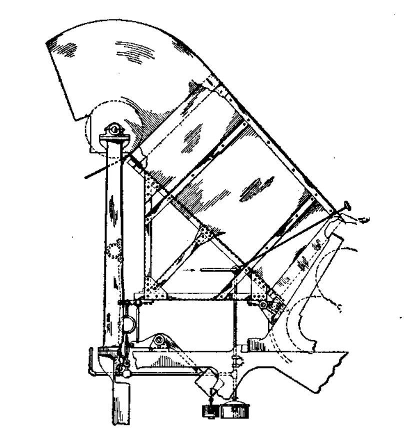
BRICK SURFACING MACHINE.—C. F. THOMAS, Buckeystown, Md. The primary object of this invention is to provide a device which will press a brick so as to leave the



BRICK SURFACING MACHINE.

surface in a perfectly smooth condition, and which will deliver the brick thus surfaced. A further object is to provide novel means for first applying pressure upon the sides of the brick, then upon the ends, and finally upon the top and bottom.

AUTOMATIC FEEDER FOR MILLS, CRUSHERS, SHREDDERS AND THE LIKE.—J. A. PIETSCH, 1383 Union St., Brooklyn, N. Y., N. Y. The object here is to provide an arrangement, whereby the power will be controlled as the material is being fed to the rollers. Also, to provide a counter-balancing device for the



AUTOMATIC FEEDER FOR MILLS, CRUSHERS, SHREDDERS, ETC.

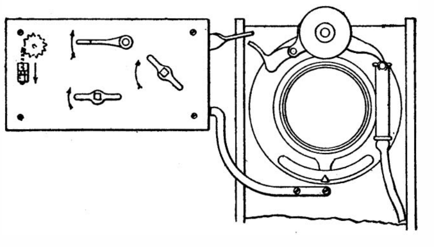
chute which acts for maintaining the power turned on until the chute has received a predetermined amount of material. Means provide that when the chute is in one position the power is permitted to operate the feeding carrier, and as the chute is moved to another position by the weight of the material in the chute the power is gradually turned off.

GRINDING MACHINE.—R. K. MCDOUGAL, 1542 O St., R. 2, Lincoln, Neb. The object in this case is to provide a machine especially adapted for grinding the cylinders of explosion engines, without the necessity of moving the cylinder, and wherein all of the cylinders of the multi-cylinder engine may be ground, without the necessity of clamping the cylinders, with the consequent distortion of the bore.

VIBRATING SCREENING AND SIZING DEVICE.—A. E. CUSTER, 703 9th Ave., Salt La e

**City, Utah. This inventor provides a device for economically treating ores in which the over-size is separated from the fine material, the latter being fed to an amalgamator, or device for final treatment of material in the form of a thickened pulp. He also provides a screen in a launder operated by the water which passes through the launder.**

CAMERA ATTACHMENT.—W. E. MULHOLLAN, Juneau, Alaska. In this patent the invention has reference to photography by aid of a camera, and more particularly compre-



CAMERA ATTACHMENT.

hends an attachment for automatically operating the shutter of the camera at the expiration of a predetermined time limit, for which time limit the attachment is set beforehand, at the will of the operator.

AUTOMATIC HAND FIREARM.—A. FYRBERG, 96 Chambers St., Worcester, Mass. The breech block can be readily disconnected from the recoil spring device to allow of moving the breech lock rearwardly by hand with a view to permit the first cartridge in the magazine to pass to position for being pushed into the barrel on returning the breech block and whereby the complete withdrawal of the breech block and the firing pin carried thereby can be had for repairs or other purposes, and whereby the barrel can be quickly and securely fastened in position on the frame.

DISK HOLDER.—J. A. MAKER, Torrey Bldg., Duluth, Minn. This invention relates to disk holders of the type employed in connection with abrasive disks of small size, such for instance, as are used by dentists, the more particular purpose being to provide an efficient mounting for the disk while the latter is subjected to rapid rotation.

CRUSHER.—A. W. WARSEN, 1440 E. 15th St., Brooklyn, N. Y., N. Y. This improvement has reference to crushers of the jaw type; and the object thereof is to provide a simple, strong, and inexpensive crusher by means of which material can be crushed to varying sizes, not exceeding a predetermined maximum.

BROOM MACHINE.—F. W. REESE, Paris, Ill. The object here is to provide an easily operated machine for holding a broom handle during the formation of the broom, wherein a normally operative gripping device is held in inoperative position by a latch or other means, which is released by the insertion of the handle into the machine.

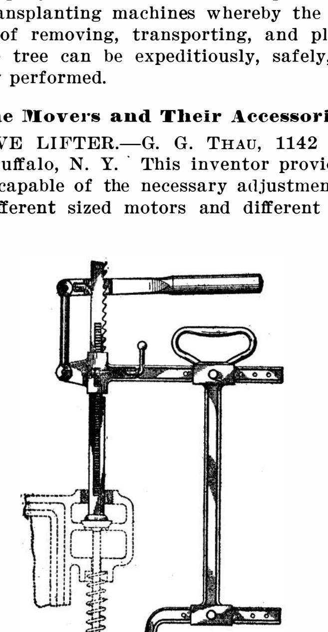
VALVE.—N. B. CREIGHTON, Chicago St., between Horton and Ivy Sts., Elmhurst, N. Y., N. Y. The object of the present invention is to provide a valve which is normally held in open position for the passage of gas, liquid or other fuel and is arranged to permit closing from a distant point and to close automatically in case of a fire with a view to stop the flow of fluid through the valve.

MULTIPLE SIGNATURE MACHINE.—W. F. WILLIAMS, Box 100, Miami, Ariz. In the present invention Mr. Williams provides improved forms of supporting bearings for the several relatively movable parts, whereby friction is practically eliminated, allowing free swinging and sliding movements as are required for a successful operation of the device.

TREE REMOVING MACHINE.—H. C. LEWIS, East Rockaway, L. I., N. Y. The invention has for its general objects to improve and simplify the construction and operation of tree transplanting machines whereby the operations of removing, transporting, and placing a large tree can be expeditiously, safely, and cheaply performed.

### Prime Movers and Their Accessories.

VALVE LIFTER.—G. G. THAU, 1142 West Ave., Buffalo, N. Y. This inventor provides a device capable of the necessary adjustments to suit different sized motors and different sized



VALVE LIFTER FOR INTERNAL COMBUSTION ENGINES.

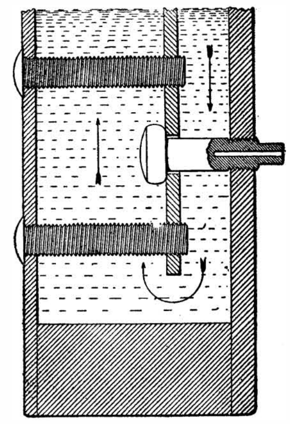
**valves. He provides a lever for effecting the clamping or gripping of the valve, and provides on the frame of the device a handle so situated** relatively to the lever, that one man alone using the device can so manipulate it as to remove or replace a valve from a dismantled cylinder without tipping over the latter.

ROTARY ENGINE.—E. N. BATY, 1325 Norton Ave., Des Moines, Iowa. Mr. Baty's invention has for its object the provision of a rotary engine having means for opening and closing valves in a cylinder as a piston rotates therein, steam being supplied to the cylinder through one end of the piston shaft and the piston and the steam being exhausted through a port in the other end of the piston shaft.

PRESSURE GENERATOR.—E. B. PORTER, 132 Main St., Penn Yan, N. Y. The invention provides a pressure medium to be used for power purposes; for example, as the motive agent in prime movers of almost any type; and it has for its primary object the generation of the required pressure in a manner that will avoid all waste and losses and make available for the purpose mentioned every particle of energy generated.

INTERNAL COMBUSTION ENGINE.—F. E. BAKER, Birmingham, England. This invention relates to internal combustion engines, such as are used for propelling motor cycles and other motor vehicles, and refers more particularly to the type of engine in which a change-speed gear is contained in the crank casing.

STAY BOLT.—D. J. O'BRIEN, Box 1002, Jerome, Ariz. The invention refers more particularly to the flexible type of stay bolt associated with a partition in the boiler for perfecting the circulation of the fluid to be heated.

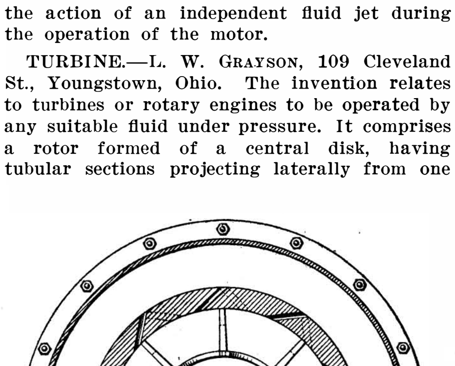


STAY BOLT.

It provides a stay bolt and partition of simple, strong, and durable construction, which bolt has means for readily indicating any injury thereto, and which will insure at all times a universal tensile strength.

CURRENT MOTOR.—C. C. COOKE, Allison St., Howard, Pa. This invention relates more particularly to a current motor, including an endless chain suitably mounted and carrying a series of feathering wings or blades whereby to form the water wheel, and a support in which the water wheel so constructed is disposed, and whereby each of the wings or blades on the lower run of the chain is subjected to the action of an independent fluid jet during the operation of the motor.

TURBINE.—L. W. GRAYSON, 109 Cleveland St., Youngstown, Ohio. The invention relates to turbines or rotary engines to be operated by any suitable fluid under pressure. It comprises a rotor formed of a central disk, having tubular sections projecting laterally from one



TURBINE.

side of the disk, and radial blades to each side of the disk above the sections, with openings in the disk establishing communication between the tubular sections and each side of the disk.

### Railways and Their Accessories.

TRAIN PIPE.—J. M. DORAN, 250 21st St., Ogden, Utah. This invention is for use especially for conducting steam, water, gas or air throughout the cars of a train. While intended for use especially for connecting cars, the construction is such as to enable it to be adapted for forming a pipe connection between bodies which have a vibration or relative motion with respect to each other.

TRACK GAGE.—R. A. HENINGTON, Section Foreman, Washington, Miss. The invention relates to means for indicating a variation in **the width of a track; and it has reference more particularly to a device which may be provided on vehicles used for inspection of tracks. It provides a device which will indicate spreading in the track by giving an alarm at the places where the spreading has taken place.**

TRAIN SIGNAL APPARATUS.—J. S. ALLEN, 115 Broadway, New York, N. Y. The improvement provides a train signal apparatus, in which the signal is thrown into danger position by mechanism operable by a weight when a train is on a certain section of the track, the weight being raised by a motor, when the train reaches the said section of the track, to throw the signal into safety position.

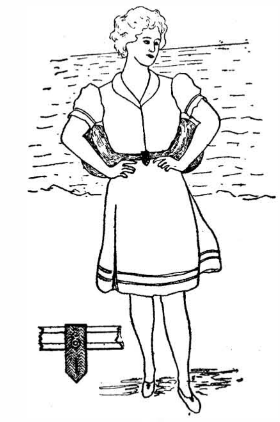
### Pertaining to Recreation.

GOLF CLUB.—H. P. DIXON, Wallingford, Pa. This improvement provides a golf club arranged to provide the desired rigidity in a

GOLF CLUB.

portion of the stick or shaft adjacent the head with a view to cause the shaft to flex near its middle to enable the player to drive the ball accurately with full force in the desired direction and to prevent the head from becoming accidentally detached when using the club.

WATER WINGS.—C. HOLROYD, 3412 Bates Ave., Pittsburgh, Pa. This invention refers to inflated bags commonly known as water wings and used by persons who are unable to swim, and the main object thereof is to provide a means for connection with the bathing suit in order to prevent the wings from escaping from



WATER WINGS.

the bather, and to prevent the wings from slipping to one side of the body, both of these faults in the water wings as now provided tending to decrease the confidence of the bather, particularly when being taught to swim in deep water.

GAME APPARATUS.—I. F. STILL, 109 Main St., Ossining, N. Y. This invention provides an apparatus with which may be played a game which will not only interest the players, but which will instruct them as to geographic divisions and localities and the principal products which are produced in the said locali-

GAME APPARATUS.

ties. The engraving shows a plan view of the board which is used in playing the game and showing the positions of the cards representing commodities. Each card has the name of a State or locality, the name of a commodity which the card represents and the words indi**cating the best method of shipping the commodity and the cost of shipment.**

### Pertaining to Vehicles.

AUXILIARY ACTUATING DEVICE FOR THE BRAKE MECHANISM OF AN AUTOMOBILE.—E. A. DIETERICH, 910 Caldwell Ave., Bronx, N. Y., N. Y. In carrying out this invention use is made of a manually-controlled electrical mechanism connected with the regular brake mechanism of the automobile and having electrically-controlled operating means extending within reach of the occupant of the rear seat of the automobile. Mr. Dieterich has invented another device of the same title as the first, in which use is made of a manually-controlled mechanism connected with the regular brake mechanism of the automobile, and having operating means extending within reach of the occupant of a rear seat of the automobile.

FIRE PROTECTOR AND ANTISKID DEVICE.—W. S. RAWLINGS, Marshall, Ind. This invention employs transverse chain elements, together with means to secure said elements in position. The device is made in small sections, for use as a boot over an outside patch, or made to extend completely around a tire as an antiskid device and tire protector.

TIRE REST.—W. H. HOLTBY, Hobart, Okla. This invention provides a support for an automobile or like vehicle provided with rubber tires for holding the vehicle in elevated position with the tires out of contact with the supporting surface for the vehicle. Mechanism is provided for permitting the vehicle to be moved off and on to the support under its own power.

AUTOMOBILE HEATING DEVICE.—E. RUTTLE, care of Rosedale Green Houses, Licking and Michigan Aves., Covington, Ken. This invention provides a device by means of which an automobile may be heated by the waste products of combustion from the engine. It provides a heating device in which the pure fresh air is heated, thus dispensing with all obnoxious odors. It further provides a heating means which may be regulated so as to heat the vehicle or not as desired.

FUEL MIXING DEVICE FOR INTERNAL COMBUSTION ENGINES.—W. F. JENKINS and R. L. JENKINS, 400 Seminary Ave., Ginter Park, Richmond, Va. An object here is to provide a device which may be readily applied to the intake manifold of internal combustion engines of any standard make of automobile without necessitating any changes whatever in the number or shape of the parts of the apparatus to which the device is to be applied.

WAGON LOADING APPARATUS.—G. HAISS, 141st St. and Rider Ave., Bronx, N. Y., N. Y. The invention relates to apparatus for facilitating the loading of wagons with material, or for the transference of material in a pile to another point, and it has to deal more especially with a wagon-loading machine of that type which is itself a vehicle capable of being transported from place to place.

### Designs.

DESIGN FOR A HANDLE.—F. S. DICKINSON, care of Becton, Dickinson & Co., Rutherford, N. J. In this ornamental design the handle is shown in perspective view; in a sectional side elevation of the palm rest of the handle and with the shank shown in elevation; and in a cross-section of the same with the shank shown in elevation.

DESIGN FOR A BOTTLE.—F. K. WOODWORTH, care of The C. B. Woodworth Sons & Co., Rochester, N. Y. In this ornamental design the bottle is shown in three views: a side elevation, an edge view, and a plan view.

DESIGN FOR AN ARTICLE OF MANUFACTURE.—LÁZARO DE LA GARZA, Torreon, Mexico. Address R. E. Navarro, care of Norris Peters Co., Washington, D. C. Mr. de la Garza has invented six new and original ornamental designs, designated in each case as a Design For An Article of Manufacture. The designs are numbered 47,028, 47,029, 47,030, 47,031, 47,032, 47,033, and are under date of March 2nd, 1915. All are in form very nearly that of U. S. treasury notes, and cover a wide range in character from the plain to the ornate.

DESIGN FOR A NECKTIE.—A. BENNETT, 123 Prince St., New York, N. Y. In this ornamental design for a necktie the article represents a very original and attractive formation.

---

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

---

### Wireless Telegraph and Railroading

*(Concluded from page 338.)*

headquarters are instructed to listen for a period of five minutes, and if no one is calling, they call the nearest station for a period of five minutes. The result is that the various stations get into communication with one another in a very few moments.

During the year 1914, two very bad storms were experienced. One in March completely wrecked pole lines in New York, New Jersey, and in Pennsylvania, and the only means of communication for ten days was the wireless.

Again early in December these regions were visited by a severe ice storm, and for a period of three days, the wireless was the only means of communication. In both these instances the results were entirely satisfactory. The total loss of means of communication is a thing of the past. It is a fact that the first wireless train order was transmitted by the Lackawanna Railroad between Scranton and Binghamton on November 18th, 1913.

Besides the communication between a train and a fixed station, constant communication is possible between all the fixed stations. The country between these stations is mountainous, but nevertheless, the service is excellent.

As seen from the data of stations, the installation at Hoboken is the largest. The photographs herewith are of that station and a description of it may interest the readers of this journal.

The large tower to the right of the picture is 402 feet high from the foundation to the ball on top of the pole. The base of this tower is 40 feet square, and the weight of steel used in the construction of this support is 15 tons. The tower was constructed by the railroad company at a cost of $5,000. The other tower, left of the picture, which is part of the passenger station, is 175 feet high. The aerial consists of six phosphor bronze wires stretched between these towers, a distance of 600 feet. The spreaders and insulators can be seen in the photograph.

The station proper is located in the passenger terminal. The transmitting set is situated in back of the two panels, and is as follows:

The transformer, which can be seen under the left panel or switchboard, is 5 kilowatts with an overload capacity of 7½ kilowatts. The primary voltage is 220 and the secondary 12,500, with a frequency of 500 cycles. The condenser unit is made up of 16 large copper coated jars.

The oscillation transformer is of the pancake type, and its coupling is varied by simply turning the lower knob on the panel to the right. Six pancake type helices are used for stepping up the wave to high wave lengths. These loads are varied by the top knob on panel to right.

The meter on this panel (right) is a hot wire ammeter. Directly below it is the wheel for varying the wave length from 1,040 meters to 3,000 meters. The wavelength used at present is 2,600 meters.

The left-hand panel controls the motor generator, and contains all necessary switches and rheostats. The current enters the motor generator at 125 volts direct current and supplies the transformer with 220 volts alternating current.

In conjunction with the transformer a large variable reactance coil is used to vary the secondary voltage. The spark gap used is of the quenched type with a blower forcing a large blast of air on the gaps, for clearing and cooling the same.

In back of and a little to the right (Fig. 2) of the aerial switch, the relay for breaking the primary current can be seen. The relay is operated by an ordinary telegraph key, which may be seen to the right of the operator's hands.

The receiving set is of Marconi design and consists of what is known as their valve tuner. In conjunction with this are many other instruments to form a more selective system of tuning. As seen from the picture the set for reception is a rather complicated affair, and the electrical connections are kept secret by the builders of the apparatus.

The Lackawanna Railroad Company has not made any tests for distance, but

nevertheless, such stations as Nauen, Germany, and stations of similar distances are heard very clearly and at all times of the day.

The operator in charge of the station at Hoboken is Mr. Gillon, a man who has had great experience in radio work.

### An Important Development in Color Photography

(*Concluded from page 341.*)

fitted, carrying the two filters and plate holders, so that first one picture can be taken, then the back slid along and the other picture taken at once. This camera enables the two exposures necessary to be given very rapidly one after the other, the total exposure, using the powerful artificial light which has been adopted, being only about three seconds. Great attention to detail is necessary in the process, if the best results are to be obtained.

Portraits produced by this process are in the form of transparencies and are intended to be viewed in a special illuminator which lights them evenly from behind by electric light, this illuminator being attachable to any electric light fitting. Finished portraits illuminated in this manner add to the attractiveness of library or living-room.

The process cannot be used for the production of paper prints, and in most cases it is convenient to transform the original negatives into the finished positive, but, if desired, duplicates can be made by making contact positives from the original negatives, from which new negatives are printed which are then transformed into the color images. This duplication process enables retouching, both of the negative and positive, to be employed if desired.

The new process, according to its inventors, is not well adapted, in its present form, to outdoor subjects, especially where blue sky is included in the picture. The limitation of the process to transparencies must also be remembered. It represents, however, a highly satisfactory and practical method of obtaining beautiful color portraits having first-rate photographic quality and giving a pleasing reproduction of the colors to the original.

### Color Music

(*Concluded from page 343.*)

must be disposed of for the protection of the filters. The filters differ for the several hues. In some cases they consist of two thicknesses of colored glass bound together. In others, of one clear glass, a thickness of theatrical colored gelatine and one colored glass, and in still others, the colored gelatine is employed between two clear glasses.

As examples, to effect the hue of green, two thicknesses of imported green glass are used, between which two different kinds of green gelatine are placed; but to effect the hue of red, a single thickness of red glass is employed.

In all cases, the principal desideratum in the construction of the filters is approximately mono-chromatic light, with a minimum of absorption in the filter. The light units are equipped with thin metal closing strips, with a view to the avoidance of leakage of white light through the openings left for the ventilation of the color filters.

The light units, with the filters, were mounted for this concert on a horizontal belt revolving on pulleys in turn mounted upon a rigid steel frame. A small motor mounted upon this frame drove one of the pulleys through a worm gear and revolved the belt. To avoid the numerous moving electrical contacts which would be required by a continuous revolution of the belt, arrangements were made for the automatic reversal of the motor field; in this way, with each half-revolution of the lamps, the motor was reversed, each lamp moving through an arc of 180 degrees and returning over the same path.

To conform to the limitations of the space available on the stage of Carnegie Hall, the belt was arranged in an ellipse thus bringing one row of lamps behind the other and removing it by about thirty inches.

The hues thus provided were thrown

upon diaphanous materials, which, in sheets of about 8 feet by 10 feet each, were mounted vertically directly over the light sources. The materials in the front of the group were most diaphanous, the others being graduated until the last was reached, which consisted of a rather heavy mesh net, presenting a large surface for reflection purposes. The whole body of gauzes was mounted within a black square inclosure, thus preventing the play of light upon the surrounding surfaces and distracting from the colors as displayed on the gauzes. The effect of this arrangement was that the observer saw the light of one hue displayed upon the rear gauzes and the light of a different hue displayed upon the front gauzes, the one being visible through the other.

The final result of this was a beautiful combination of hues not precisely identical in any two portions of the screen and varying in appearance, as does changeable silk in dress materials, when shown under strong light. This arrangement avoided a difficulty which would otherwise have been experienced had the colors been juxtaposed or superimposed upon one surface. At the same time the slight appearance of animation obtained by moving the light sources slowly around as the belt revolved operated to avoid the monotony which would have been consequent upon the employment of a given hue uniformly in a given portion of the screen. It produced, also, much more interesting blends of color, and any combination of two colors which was displayed for a number of measures of the music changed its precise appearance continually and at no time became monotonous.

The space occupied by the color apparatus, outside of the keyboard, was about 10 feet by 5 feet. The apparatus was 16 feet high, from the floor to the top of the gauze.

It must not be supposed that this is the first attempt to treat color musically. Readers of the SCIENTIFIC AMERICAN will recall that Prof. Rimington of London devised what he calls a color organ which was to do for light what a symphony orchestra does for musical sounds. So far as we are aware, Prof. Rimington's scheme was never carried out in practice on a large scale, so that the performance of Scriabine's "Prometheus" may probably be regarded as the first successful experiment of its kind that has ever been made.

### Bricks Without Clay

MAKING bricks without straw is a familiar quotation, but making them without clay, or its equivalent, which from time immemorial has been the essential ingredient, is a novel suggestion. This, however, is what is now proposed, and a plant is being built in Illinois. According to the *Railway Age Gazette*, the process consists in chemically combining any coarse material containing silica with a binder of finely divided particles of silica, alumina, potassium, or sodium in suitable proportions to insure a binder with a low fusing point, as compared with the coarse body material. The bricks are molded under high pressure, preferably in a dry state, and are fired in a manner similar to that used in making ordinary brick, but the time required is not nearly as long. Bricks made by this process have been tested and have shown very satisfactory absorption qualities, and have withstood a temperature of 2,900 deg. Fahr. without cracking or showing damage. They have undergone crushing tests of 20,000 pounds per square inch without failure. The samples examined show a texture capable of taking a high polish, and the grain is so fine that clean-cut carving is possible, but these qualities evidently depend on the character of the material of which bricks are made. It is proposed to use the tailings from coal mines at the new Illinois plant, and it is stated that, on account of the wide variety of materials that can be used in the new process, including many waste products, these bricks can be profitably made in localities where ordinary brick cannot be produced on account of the absence of suitable clay.


Cork Tip
or Plain End
15¢
MOGUL
EGYPTIAN
CIGARETTES
"JUST LIKE BEING IN CAIRO"
Anargyros
A CORPORATION
Makers of the Highest Grade Turkish
and Egyptian Cigarettes in the World


GOOD NEWS for all Friends and
Admirers of Egyptian Plain End Cigarettes
MOGUL
EGYPTIAN
CIGARETTES
MOGUL
EGYPTIAN
CIGARETTES
Anargyros
A CORPORATION
SELECTED
TURKISH
TOBACCO
the most delectable of all Mild
cigarettes may now be had
PLAIN END
In the convenient FLAT BOX
with the PROTECTIVE INNER
FOIL and OUTER LINEN
WRAPPER. 15¢
Anargyros
A CORPORATION
Makers of the Highest Grade Turkish
and Egyptian Cigarettes in the World.

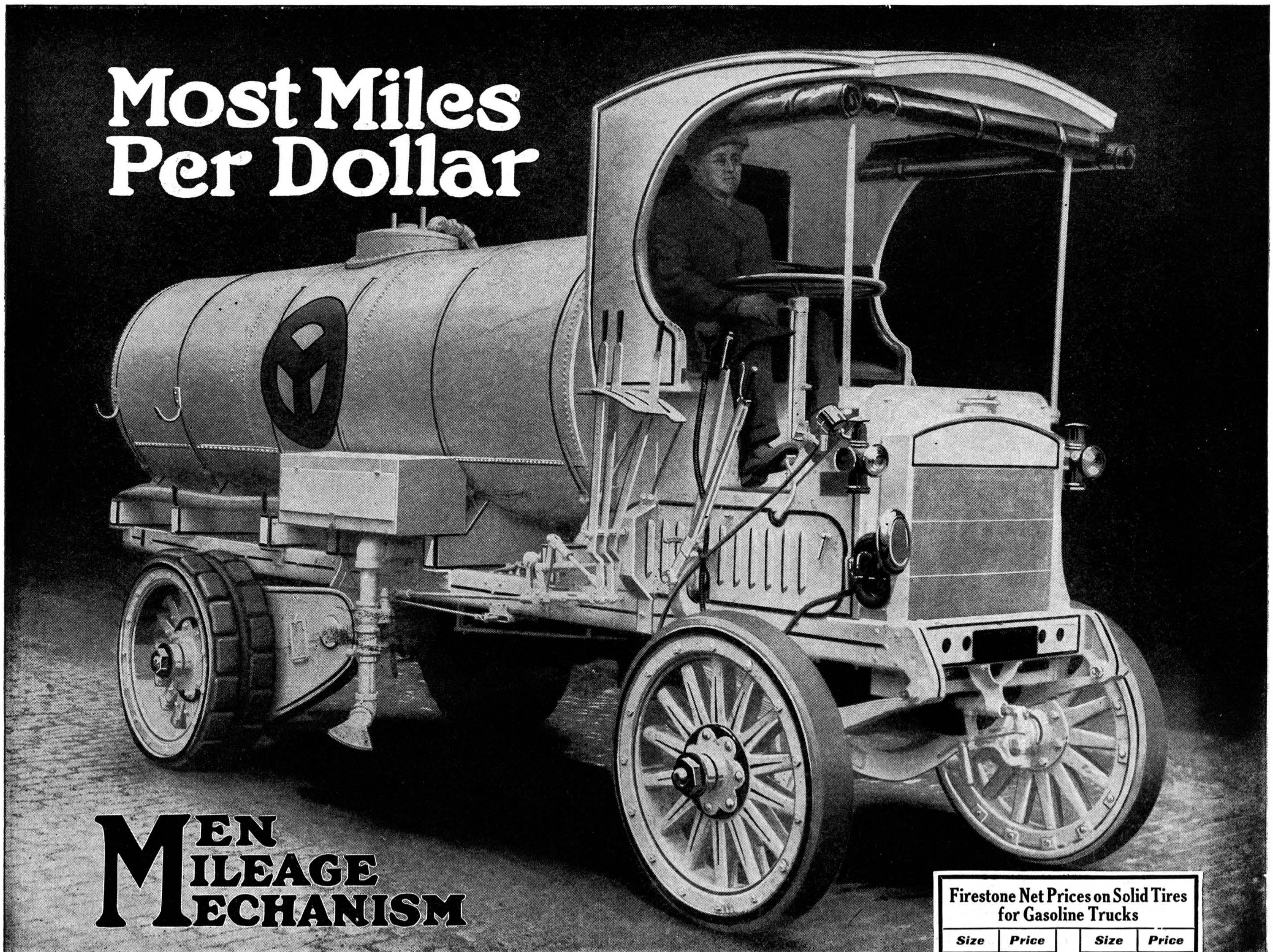
# SCIENTIFIC AMERICAN

THE SHELL FIRED BY THE AUSTRIAN 30.5 SKODA HOWITZER

Vol. CXII. No. 16
April 17, 1915

Munn & Co., Inc., Publishers
New York, N. Y.

Price 10 Cents
$3.00 A Year




Firestone Net Prices on Solid Tires for Gasoline Trucks

| Size | Price | Size | Price |
|---|---|---|---|
| 36 x 2 | $12.60 | 36 x 4 | $35.10 |
| 32 x 2½ | 17.05 | 36 x 5 | 42.95 |
| 36 x 2½ | 18.95 | 42 x 5 | 49.95 |
| 34 x 3 | 22.10 | 36 x 6 | 52.70 |
| 36 x 3 | 23.30 | 40 x 6 | 58.50 |
| 32 x 3½ | 24.55 | 36 x 7 | 64.65 |
| 36 x 3½ | 27.35 | 40 x 7 | 71.90 |
| 34 x 4 | 33.20 | | |

# YOU do more than cut down tire mileage cost when you apply Firestone Equipment to your Trucks

You protect your drivers from the fatigue and ill-temper of needless rack and jar.

You conserve their energy. And the resiliency of Firestone Tires means more than this comfort to them. Firestone grip and traction mean easier handling, easier steering.

Truck mechanism comes in for this greater protection. Fewer lay-ups, less repair expense.

There is a Firestone Tire and Rim Equipment for every Truck and sure service need.

Call in a Firestone representative. Write for catalog.

**Firestone Tire & Rubber Co., Akron, Ohio—Branches and Dealers Everywhere**

*"America's Largest Exclusive Tire and Rim Makers"*

# Firestone

## TRUCK TIRES

SEVENTY-FIRST YEAR

SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

VOLUME CXII. NUMBER 16. NEW YORK, APRIL 17, 1915 10 CENTS A COPY $3.00 A YEAR

## Raising the "F-4"

By J. F. Springer

THE American submarine "F-4," which now lies at the bottom of the sea in Honolulu Harbor, has presented to the Navy Department a very serious problem. The actual raising of the boat, lying as she does in 40 or 50 fathoms of water, has proved a task to which local equipment and skill are unequal. The unsurmounted difficulty is concerned largely with the necessity of properly securing to the body of the vessel the chains or cables by which she is to be hoisted to the surface.

Accordingly, interest focuses upon the problem of making fast the hoisting lines. But divers capable of successfully performing the duties are very few. Some years ago Angel Erostarbe, presumably a Spaniard, went down in 182 feet of water near Cape Finisterre, at the northwestern corner of Spain, and successfully recovered some $45,000 worth of silver bars from a wrecked steamer. James Hooper went down to the depth of 204 feet near Pichidanque, South America. But these depths, great though they are, are still far short of the necessities at Honolulu.

However, the U. S. Navy has in it a number of men who have been developing the possibilities of deep diving. One of these, Chief Gunner's Mate S. J. Drellishak, has been down to a depth of 274 feet in the waters of Long Island Sound. Others have done work comparable with this. A group of these men under Gunner G. D. Stillson has been dispatched from New York for Honolulu by the Navy Department. Their duty upon arrival will be, first of all, to attach to the "F-4" the necessary lines.

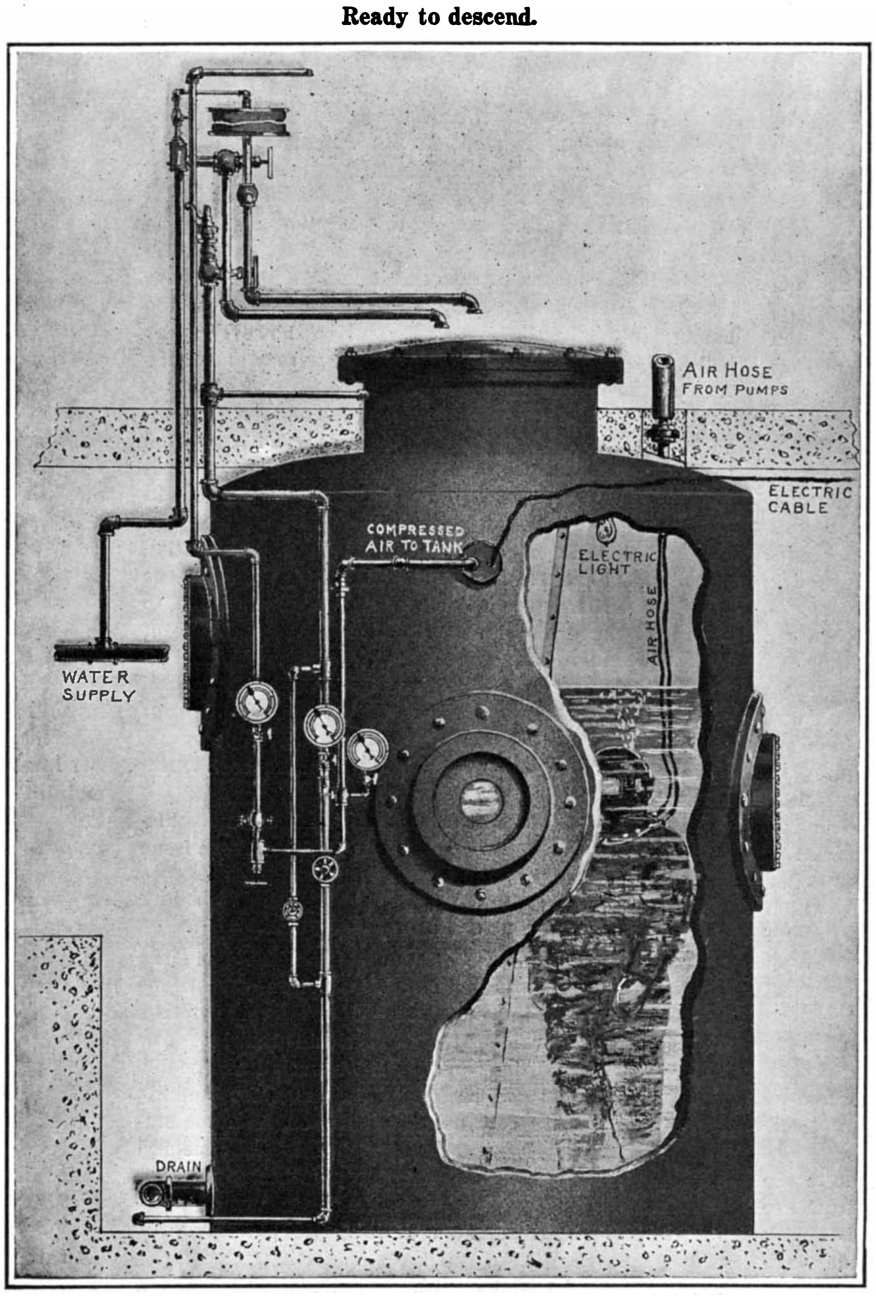
Deep diving is difficult because of the enormous pressure of the water. The pressure of the water increases at the rate of about 0.43½ pound per square inch for every vertical foot. At 200 feet below the surface the water surrounding a diver's body exerts the very great pressure of 87 pounds per square inch. Assuming a man's body to have a superficial area of 2,160 square inches, he would accordingly at this depth be subjected to a total pressure of nearly 94 short tons. At 300 feet the pressure would be 130½ pounds per square inch and 141 tons for the whole body.

Upon consideration, however, this matter seems less frightful than it does at first sight. We are familiar with the pressure of 15 pounds per square inch which we all have to endure as we live and move around on the surface. This amounts to 16 tons for the entire body. We suffer no discomfort because the external pressure is everywhere balanced by an equal internal one. The flesh of the body contains air and liquids which are also exerting a pressure of 15 pounds per square inch; so that every conceivable solid particle has in every direction two balancing pressures. The effect is to put the particle under no stress whatever relatively to other particles. One particle of the body is forced neither toward nor away from any other particle.

This equilibrium may be maintained as the external pressure is increased, thus making possible deep water diving. The depth of 274 feet has been actually accomplished with but little or no discomfort.

It is necessary, as greater and greater depths are attained by a descending diver, that pressure conditions within the body be continually increased to match the increasing external pressures. In practice, it is found that this takes place very rapidly, if the pressure of the air supplied by the diver is progressively added to at the rate of increase of the external hydrostatic pressure. That is to say, a diver may go *down* rapidly if the air pressure is kept right. Apparently, the body automatically responds and permits a rapid *increase* of internal pressures without especial discomfort. Upon ascending, however, all this is changed. A diver may make a quick descent to a considerable depth, but he may not safely make the return trip quickly. There must be stops of considerable length to permit the body to accommodate itself to the reduced internal pressure. Recent practice seems, however, to favor making the first half of the ascent a single, fairly rapid operation. The remainder of the distance is then divided into sections, with the rests at the ends of sections rather long. Altogether, to come up from 250 or 300 feet may require from one to two hours.

**Ready to descend.**




**The tank at the Brooklyn Navy Yard in which the Government divers who will assist in raising the sunken submarine received their training.**

With the modern diving equipment, the diver is in constant telephonic or other communication with those at the surface. His personal feeling that all is well is relied on largely in letting him down and hoisting him up. The diving suit enables him to live in an atmosphere of air. The tension of this air is kept continually equal to the hydrostatic pressure without. Consequently, he has a means of knowing the relative pressure conditions other than the physiological sensations of his body. If he notices a distension of his suit, he knows this means that the air pressure is too great. Or, if he notices that it is pressed in upon him, he knows that this signifies too low a pressure of air.

In supplying the diver with air, provision must be made for two distinct things. First, the requisite pressure must be maintained—this despite the fact that air is being continually discharged from a valve in the diving helmet. This brings us to the second requirement. The air surrounding the diver's head must be kept fresh. He keeps breathing, absorbing oxygen and emitting carbon dioxide. If there were no outlet, the atmosphere about him would soon consist of but little else than carbon dioxide and nitrogen, when he would "drown," though still in the dry. Consequently, in addition to the maintenance of the pressure, it is necessary to provide for a continuous renewal of air.

In order to meet these requirements, the air pump must be operated more and more vigorously as the diver goes to lower and lower depths, or more and more powerful methods must be employed. This may be illustrated by the fact that with one type of standard hand-operated air pumps, a single cylinder will supply a diver with sufficient air in cases where the pressure does not exceed 21 pounds per square inch. Where the pressure is greater than this, but less than 42 pounds, two cylinders are required. For pressure running up to 78 pounds, four cylinders are necessary; and six cylinders from this pressure up to, say, 90 pounds. At Honolulu, the pressure required may run up to 125 pounds or more, and will probably be supplied by a power-operated air compressor.

The diver has to be alert as to whether the proper pressure is being maintained and also as to whether the air is supplying him with enough oxygen. This lat-

(Concluded on page 367.)

# SCIENTIFIC AMERICAN

Founded 1845

NEW YORK, SATURDAY, APRIL 17, 1915

Published by Munn & Co., Incorporated. Charles Allen Munn, President; Frederick Converse Beach, Secretary Orson D. Munn, Treasurer all at 233 Broadway, New York

Entered at the Post Office of New York, N. Y., as Second Class Matter Entered as Second Class Matter at the Post Office Department, Canada.

Trade Mark Registered in the United States Patent Office



**Subscription Rates**

| | |
|---|---|
| Subscription one year | $3.00 |
| Postage prepaid in United States and possessions, Mexico, Cuba, and Panama | |
| Subscriptions for Foreign Countries, one year, postage prepaid, | 4.50 |
| Subscriptions for Canada, one year, postage prepaid | 3.75 |

**The Scientific American Publications**

| | |
|---|---|
| Scientific American (established 1845) per year. | $3.00 |
| Scientific American Supplement established 1876. " " | 5.00 |
| American Homes and Gardens " " | 3.00 |

The combined subscription rates and rates to foreign countries including Canada, will be furnished upon application.
Remit by postal or express money order, bank draft or check

**Munn & Co., Inc., 233 Broadway, New York**

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp* the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.


*The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.*

## Are Obsolete Battleships Obsolete?

MANY and varied are the lessons of the war, and generally speaking, the operations both on sea and land, it must be admitted, have verified the theories upon which the vast armaments of the past quarter of a century have been developed.

There are some exceptions to be noted, and among these we draw attention to the extensive use which has been made of battleships which were supposed to be obsolete and therefore unsuited to the severe tasks which modern naval warfare imposes. It has been urged, and pretty generally agreed, that when a battleship is ten years old it is becoming obsolete, and that when it is twenty years old it is entirely so, and should be stricken from the active list. This estimate has been based upon the premise that the duty of the battleship, first and last, lies in the line where it may give and take the heaviest blows of a great fleet action. The rapidity with which the military value of the battleship decreases is in the direct ratio of the rapidity with which the punishing power of the gun, the torpedo, and the mine increases. And so it has come about that we have battleships of the first line, second line and the reserve, from the last-named of which the aged ship is relegated to the scrap heap, the useful age of the battleship having been arbitrarily placed at one-score years and nothing.

Now, certain events in the naval operations of the war suggest that the period of time which elapses between the final haul down of the flag and the sale of the obsolete ship should be extended. We refer to the useful work which has been done by some of the old battleships in operations of a kind which were never contemplated by the admiralties when the present war opened. Thus, it has been well established that it was certain old British battleships which assisted so materially the work of the Belgium army in holding back the German drive for Calais, the heavy shell fire of the large-caliber guns being used with deadly effect in enfilading the German entrenchments and wrecking the gun positions.

An even more notable instance of the use of early ships was seen in the recent operations in the Dardanelles. For it is a fact that, with the exception of the "Queen Elizabeth" and the battle-cruiser "Inflexible," the operations in the Ægean Sea, formidable as they were, were carried out without calling upon any of the ships of the British North Sea fleet under Jellicoe, or the fleet of modern French battleships which is holding the Austrians secure at the northern end of the Adriatic. In the Ægean squadron are to be found such ships as the "Majestic" and "Prince George," which were laid down twenty-one years ago—ships which had come to be regarded in the British navy as not worth the cost of their upkeep. In the French navy, also, in the Ægean are to be found such armored vessels as the "Requin," dating from 1885, and the "Jaureguiberry," from the year 1895.

Some of these ships, it is true, have been sent to the bottom; but if, as is stated in the dispatches from the allied commanders, their loss was due to contact with mines, it can be said that, in view of the terrific rending power of these machines, probably the more modern battleships would also have succumbed to the attack.

And this brings to our mind the fact that the old battleships with their heavy armor and powerful guns might be used to good advantage by sinking them down to a bed of grillage, carried on piling driven into some of the shoals at the entrances to our harbors. Weighted with concrete, heavily rip-rapped, and periodically given a heavy coat of paint, these ships would provide a speedy and highly economical means of covering adjoining channels with the fire of heavy armor-piercing guns. This suggestion was illustrated and fully described in an article by a retired naval officer which appeared in these columns a few years ago. The arguments advanced then hold good to-day. We believe there is sufficient merit in the proposal to warrant its careful investigation by the Ordnance and Engineers' Corps of our Army.

## Credit for the Gatun Dam

"THERE is glory enough to go around," said one of the ranking officers engaged in the sea fight of Santiago when the question of credit for the American victory was under discussion; and the same truth applies to that great victory over the forces of nature which has been won by American brains and resources in the completion of the Canal at Panama.

In the distribution of credit (and that history will make such an allotment is certain) we wish to draw attention to the fact that, so far as the American share in the enterprise is concerned, the credit for first pointing out the advantages in the way of construction and operation afforded by building a big dam at Gatun were first formally advocated by an American engineer, Mr. C. D. Ward, a member of the American Society of Civil Engineers.

The advantages of constructing a dam at Gatun were first pointed out by M. Godin Lepinay before de Lesseps' Paris Congress in 1879. In 1880 Mr. Ashbel Welch suggested the advantages of Gatun to the American Society of Civil Engineers, and he then acknowledged that he was indebted for the idea to Mr. Ward. Neither of these engineers had at that time heard of Lepinay's plan. The suggestion had never been followed up and was soon dropped, either as being impracticable or as being supplanted by the more practicable project for a dam at Bohio.

It will be remembered that the present scheme as carried out was adopted as the result of the minority report of the Consulting Board of Engineers in 1905. Subsequently four members of the Consulting Board gave it as their opinion that the revival of the dead and forgotten plan was due to a paper read before the meeting of the American Society of Civil Engineers in 1904 by Mr. Ward. The late A. Noble in a letter dated April 18th, 1907, speaking of that paper, said: "The Ward paper created so deep an impression among engineers that one of the earlier examinations made by the First Construction Commission appointed by President Roosevelt was to determine by means of boring the depth to rock and the nature of the overlying earth along the line of the proposed dam. The earth was found to extend to such a depth that the construction of a masonry dam was found to be impracticable and the project for a dam of this kind was too hastily set aside. There were many, however, who believed with Mr. Ward, that a perfectly safe and satisfactory dam could be made of earth, and that the advantages of the location from the point of view of navigation were so obvious, that the subject was not allowed to drop, and it received favorable consideration from the minority of the Board of Consulting Engineers in 1905. . . .

"While it is impossible to say that the Gatun location would not have been adopted had Mr. Ward's paper not been written, the fact that the first suggestion to this end was dropped and remained unheeded, except by him, for more than twenty years, and that its revival was due to him exclusively, make it most probable that, but for his persistent efforts, the excellent plan of Canal now adopted would not have developed, and either an inferior lock plan or a far more costly sea-level plan would have been adopted."

The paper read before the Society has so much historical interest that we reproduce it in the current issue of the SUPPLEMENT.

## The Storage and Handling of Gasoline

THE extensive use of inflammable liquids in the arts, especially as fuel for motors of various forms, and in particular for motor vehicles, has attracted considerable attention within the last few years to the conditions under which such inflammable liquids are stored and handled. Buildings for stabling motor vehicles are now quite as common as horse stables were but a few years ago, and the inflammable and explosive character of the gasoline presents many serious fire hazards, especially where a number of these vehicles are accommodated in a single building, and where considerable quantities of gasoline necessarily must be stored and handled. The matter has been a serious one for the insurance interests, as very few States or cities have had effective laws or ordinances on the subject of inflammable liquids, and what is even more striking, has been the wide diversity of regulations as well as of practice. Thus, in some cities inflammable liquids can only be stored outside of buildings, permitting storage tanks under the sidewalk. In others, tanks under the sidewalks have been specifically prohibited. In some places inflammable liquids may be stored in a basement. In others, basement storage of inflammable liquids is expressly forbidden. In New York city, large quantities of inflammable liquids may be stored, but no considerable amount may be kept in any single container. For example, not more than 275 gallons of gasoline can be stored in a single tank, but any number of tanks may be placed on the premises, so as to secure the supply required for the number of motor vehicles or the industry concerned.

In fact, the lack of harmony in American methods and requirements has been most extraordinary. In some few cases there may be better practice than in Germany and other European countries, but in most cities conditions are such as to give rise to exceptional hazards, and serious fires have resulted from lack of care in the handling and storage of gasoline, both in private and public garages, as well as from inflammable liquids in other establishments.

Quite recently, in connection with this handling, storage, and sale of inflammable liquids, an attempt to secure more effective regulation and general harmony has been made, and a suggested ordinance has been drawn up for general adoption. This has been approved by the National Board of Fire Underwriters, whose engineers were largely instrumental in its preparation, and by the National Fire Protection Association, as well as by such organizations as the Paint Manufacturers' Association, the National Paint, Oil, and Varnish Association, the National Varnish Makers' Association, the National Dry Cleaners' Association, and the Independent Petroleum Marketers' Association, all of these organizations, and particularly the last named, actively participating in the various discussions, and contributing materially to the rules which were drawn up.

These rules are intended to represent the best practice and are reasonably strict and severe, yet at the same time not to be unreasonably oppressive in their bearing on small dealers or on the conduct of ordinary business. The aim has been to be explicit and leave as little to the discretion of municipal authorities and fire department officials as possible, for it has been found that inefficiency and possibly worse conditions are likely to result when fire chiefs or fire commissioners can make arbitrary rules.

The proposed ordinance has been designed to serve as a model, applicable throughout the country generally, and was prepared only after a thorough consideration of the many points involved and the interests of the various parties concerned.

It not only deals with the garage and the gasoline hazard in connection with motor vehicles, but also with the subject of inflammable liquids and the products thereof in general, regulating their use and handling, storage, and sale. Such liquids are grouped in three classes according to the "flash point" or temperature at which the vapor arising from them will ignite, determined with various forms of approved testers as used by the United States Bureau of Mines and fire officials generally. Inflammable liquids on this basis are divided into three classes, and gasoline, which is the fuel of most motor vehicles, is included in Class I, embracing the most inflammable liquids, Class I being defined as liquids with flash point 27 deg. Fahr. (3 deg. Cent.), closed cup tester, which is equivalent to 30 deg. Fahr., open cup tester.

The proposed ordinance has furnished the basis of recent rules or statutes enacted or promulgated by competent authority, so that, all things considered, it may be said to summarize the best American practice and requirements. These rules should result in reducing the losses from fire due to improperly constructed and maintained garages, and should, therefore, act to offset the increased hazard due to the storage and handling of inflammable liquids in ever-increasing quantities.

---

**Canada's Railways.**—Had not the war seriously unsettled industry and trade throughout Canada, the Dominion would have developed in 1915 a trunk-line railway mileage of approximately 40,000 miles, including, of course, all subsidiary or contracted lines and lines running through American territory. This would have placed the country second to no other in the world in railway standing. The completion of the Grand Trunk-Pacific system has been retarded. The line extending westward from Winnipeg to the Pacific terminus at Prince Rupert, B. C., has been in operation for som months, but the line from Winnipeg to Moncton, N. B. the terminus on the Atlantic, is not as yet completed, and the funds for its completion, under present circumstances, may not soon be available. Many expectations founded on its opening up rich territories in Ontario and Quebec will be disappointed for a while.

## Science

**The "Thinking" Horses of Elberfeld** were not, after all, killed in battle in Flanders, as has been reported in the newspapers and many scientific journals. According to a note in *Science*, the owner of the horses, Herr Krall, reports them safe and sound, though the experiments on them have been suspended during the war.

**The British Association.**—Under the heading "Science as Usual," *The Times* announces that the British Association will hold its annual meeting in Manchester next September, as arranged. On account of the war the meeting will probably be shorn of the elaborate social functions which usually characterize this annual event.

**The Work of the Coast and Geodetic Survey.**—A substantial illustrated pamphlet, issued especially for distribution at the Panama-Pacific Exposition, but also obtainable by mail, free of charge, from the Division of Publications, Department of Commerce, Washington, D. C., is entitled "United States Coast and Geodetic Survey; Description of its Work, Methods, and Organization." The varied and useful activities of this branch of the Government are set forth in interesting detail.

**Disturbance of Pheasants by Distant Cannonading.**—*The Times* and other English publications have contained numerous accounts of the disturbance noted among the pheasants of northeastern England during the North Sea battle of January 24th, apparently indicating that these birds heard the cannonading—so plainly as to be much excited thereby—though in most places it was imperceptible to the human senses. An alternative suggestion, offered by Dr. Davison, is that the disturbance of the birds was due to the sudden swaying of low trees and shrubs under the effect of inaudible air-waves.

**A Great Sun Spot Appears.**—A great sun spot estimated to be 100,000 miles long has been disclosed by the recent development of a photographic plate that was exposed at the Naval Observatory, at Washington, on March 29th. The following instructions are given by the observatory officials for observing the spot. "By holding a piece of smoked glass in front of one of the object glasses of an ordinary opera glass, with the smoked side toward the opera glass and looking through this side only, using one eye, the spot may be plainly seen. Caution should be observed not to get the full glare of the sun in the eye, and the side of the glasses not in use should be turned away from, instead of toward, the other eye, so as to avoid the possibility of the sun's rays striking that eye through the glass."

**Trees that Keep Weather Records.**—In cutting up logs for experimental purposes at the Madison, Wis., laboratory of the U. S. Forest Service it was noticed that in a number of them there were little diagonal streaks, or wrinkles, running across the grain, and that these appeared entirely on the same side of the trees. It was well known that these wrinkles indicated compression failures, such as result from too great a strain on the fiber at some time, either from bending in a storm, or from rough handling; but as all of the logs in question came from the same locality in Florida, and the markings were all on the north side of the log, it was assumed that they were caused by some severe storm from the south that had swept over that part of the country. By carefully counting the annual rings of wood, and knowing when these trees were cut, it was decided that the storm recorded by the wrinkles must have occurred in the year 1898; and inquiries verified the fact that at that time a hurricane had swept over that region.

**A New Immunization Theory.**—According to a new theory of immunization against bacterial disease evolved by Drs. Henry Smith Williams and James Wallace Beveridge, two New York physicians, the red and white corpuscles of the blood are the chief agents that protect human organisms against the ravages of bacteria, and this they have termed the proteomorphic theory. These investigators believe that the white corpuscles deal with the unbroken proteins that they may come in contact with, whether they be of bacterial or dietetic origin, and that the red corpuscles deal with the partially cleaved molecules of protein. In other words, the business of the white corpuscle is to break down or cleave this protein molecule, not synthesize it. And in summing up *American Medicine* condenses their statement: "In this view, then, the red blood corpuscles have an immunizing function strictly complementary to that of the white blood corpuscles, and no less important. One legion of cells co-operates with the other, each having its own special field. The white corpuscle deals with all formed bodies and full-sized protein molecules of foreign type that make their way into the blood stream. The red blood corpuscle deals with the later cleavage products of protoplasmic activity. In carrying out their respective tasks, the leucocyte supplements the work of the ferments of the digestive tract; the red corpuscle supplements the work of the leucocyte and relieves the ultimate tissues in considerable measure of the task of protecting themselves against small-moleculed nitrogen products that might prove harmful."

## Astronomy

**The Royal Astronomical Society** has decided, by a vote of 59 to 3, to admit women as fellows and associates.

**"L'Astronomie,"** the monthly bulletin of the Astronomical Society of France, which suspended publication at the outbreak of the war, has now been resumed, and the missing back numbers have been issued, so that there will be no break in the files.

**Arthur von Auwers,** the well-known German astronomer who died January 24th of this year, was born in Göttingen in 1838, and moved to Berlin in 1866 when he became a member of the Berlin Academy of Sciences and academic astronomer. Auwers was pre-eminent among European astronomers in studies on the proper motion of stars, but also made many important investigations in other branches of astronomy.

**Adam Massinger,** assistant at the Heidelberg observatory and known as the discoverer of several asteroids, was killed in action near Ypres October 21st. It is an interesting example of the irony of fate that Massinger named the first asteriod he discovered "Nipponia," in honor of Japan. During the last few years he had been engaged on a laborious examination of all the nebulæ of Herschels' general catalogue found on the Heidelberg photographic plates, and was preparing to use the statistical material thus collected concerning upwards of 4,400 of these bodies in a study of their distribution in the stellar system.

**New Asteroids.**—The Astronomisches Rechen-Institut, at Berlin-Dahlem, announces that 76 new asteroids were discovered in the year ended June 30th, 1914; viz., 26 at Heidelberg, 5 at Johannesburg, 1 at Nice, 1 at Paris, 19 at Simeis, 3 at Vienna, and 20 at Winchester, while 1 was discovered on the same night at Heidelberg and Simeis. Permanent numbers have been assigned to 32 of these, as well as to 5 discovered the previous year, and the elements of these 37 have been published. The total number of these bodies whose orbits are now definitely known which have consequently received permanent numbers is 791.

**Saturn's Crepe Ring.**—The crepe ring of Saturn has been observed and measured at the Lowell Observatory persistently wider on the east than on the west side of the planet during the past month by a difference of five hundredths. This fact will have important bearings on the mechanics of the stability of the ring. Any phase effect or defect of illumination of the constituents of the ring are not sufficient to explain the phenomenon on account of the diminutive size of the meteorites composing it. A possible explanation of this detected eccentricity of the ring may be the revolution of its perisaturnium.

**The German Eclipse Expedition in Russia.**—Four German observatories—Berlin, Hamburg, Munich and Potsdam—sent expeditions to the Crimea to observe the solar eclipse of August 21st, 1914. These parties reached their stations about the end of July and were busy with preparations for their work when the outbreak of the war caused them to depart hastily for Germany, leaving their instruments behind at Theodosia. Having proceeded as far as Odessa by boat, they were all declared prisoners of war. Ultimately most of them were released and got home in safety, but four—viz., Dr. Zurhellen of Berlin, Dr. Kühl of Munich, and two assistants of the Hamburg party—were kept in captivity, and are supposed to have been sent to Astrakhan. The instruments left at Theodosia were confiscated by the Russian authorities and turned over to the University of Odessa.

**Early Chinese Records of Eclipses.**—Messrs. Hirayama and Ogura have published in the *Proceedings* of the Tokyo Mathematico-Physical Society the results of their attempts to fix the dates of some early eclipses recorded in Chinese literature. The earliest is mentioned in one of the books of the Shu Ching, where it is recorded that in the reign of Chung K'ang, the fourth emperor of the Hsia dynasty, there occurred an eclipse of the sun which had not been predicted by the astronomers, who were alleged to have been drunk and to have neglected their duties. Hence the customary rites for delivering the sun, which should have been arranged in advance and superintended by the astronomers, were in the emergency performed by other officials without proper preparation. The emperor accordingly ordered the army to punish the astronomers. A later document makes it possible to fix the date of this event as October 13th, 2127 B. C. (Julian calendar)—the earliest recorded eclipse in the world. Calculation shows that there actually was a solar eclipse on that date, but probably not in China, though the elements of the motions of the sun and moon are not accurate enough to indicate certainly the path of so remote an eclipse. The authors are inclined to think that the information fixing the date of the eclipse is due to Chinese astronomers of a later age, who calculated that an eclipse occurred on that date and erroneously supposed that it was visible in China.

## Automobile

**Wanted: 20,000,000 Tires in 1916.**—Granting that the average consumption of tires by motor cars is eight tires per car per year, which includes all types of vehicles, there will be required during 1916 not less than 20,000,000 tires, valued at from $300,000,000 to $400,000,000—figuring the average price of tires at $15.

**Lubricating Spring Leaves.**—A new device for the lubrication of the leaves of automobile springs has been brought out by a Providence firm. The device is essentially nothing but a pair of plates, bolted one on each side of the spring. Each plate incloses a small oil reservoir and a felt wick, the latter pressed against the edges of the spring leaves and feeding the oil between.

**New Aluminium Solder.**—A solder for aluminium which can be used without flux, has been evolved by a New York company, which sells it by the pound, in convenient sticks weighing about 5 ounces each. The solder is applied with any convenient piece of iron, while the heat of a gasoline torch is all that is necessary to cause junction. At the soldered joint the metal is stronger then the aluminium itself. The aluminium will not oxidize during the soldering.

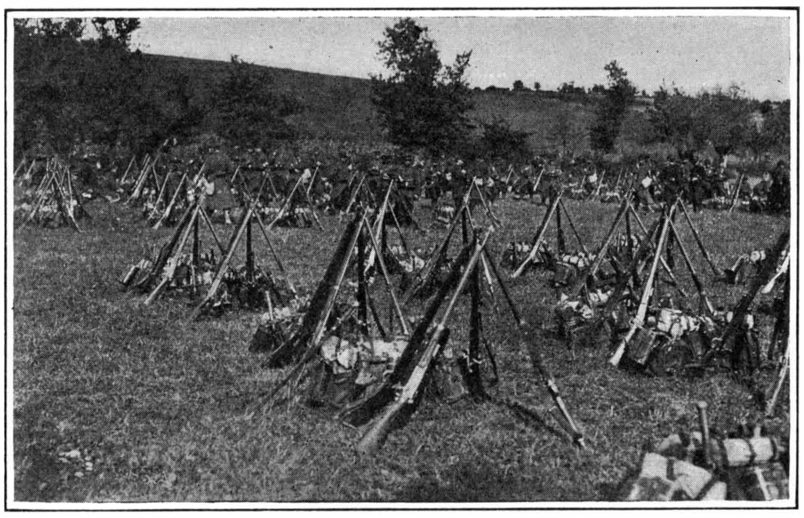
**Ball Bearings Still Imported.**—Fears that the imports of ball bearings would completely cease because of the war, appear to have been groundless. Despite the embargo placed by the German government upon bearings exports, the quantity and value of these necessities for motor cars have not been less in the seven months ended January 31st, 1915, than in the same period ended January 31st, 1914. Most of the shipments now come from Italy and Sweden.

**A Rubber Regenerator Wanted.**—A prize of $25,000 has been offered by the German government for a satisfactory process of regenerating rubber. It is not merely a "reclaiming" process that is desired, but a real "regenerating" process. The resiliency of the original rubber must be regained to an extent of at least 90 per cent in order to make the process eligible for competition. The tire problem is beginning to worry the army authorities, and negotiations are said to be pending with the manufacturer of a well-known fiber tire, of the tension type, which is expected to solve the difficulty of obtaining rubber for pneumatics in sufficient quantity for army needs.

**Safety Devices for Automobile Starting Motors.**—A patent has been granted F. H. Miller of Wilkinsburg, Pa., assignor to Westinghouse Electric and Manufacturing Company, No. 1,130,004, for a safety device for starting motors of automobiles. The object is to protect the gears of a starting motor for an automobile engine by preventing the connection of the motor to the engine shaft when the latter is rotated above a predetermined speed and in doing this the party utilizes centrifugal force to control means for preventing the establishment of an operative connection between the starting motor and the engine shaft. Another patent, No. 1,130,573, for a similar purpose has been issued to Frank Conrad of Liversvale, Pa., assignor to Westinghouse Electric and Manufacturing Company, in which patent there is employed the usual reduction gear mechanism which operatively connects the motor to the engine fly wheel, and the invention provides a device which automatically locks the starting mechanism in an inoperative position when the fly wheel is rotated but allows the connecting gears to mesh if the fly wheel is at a standstill, thus avoiding any operation of the starter when the engine shaft is operated.

**Saving Time by Combination.**—One of the most peculiar results of the modern system of quantity production of automobiles is undoubtedly the tendency to combine certain accessories, in order to save material and, especially, to save time in the assembling of the car. A few minutes saved in the putting together of the minor parts of the car, means an aggregate saving of many days' work when a production of 50,000 or more cars is concerned. Some of the most recent attempts along this line are the following: One company is using a headlight with hollow perforated rim. This rim is really the horn end of the electric warning signal, the buzzer of which is directly behind the electric light bulb. Not only is the mounting of the horn unnecessary, but the sound is carried forward better, because of the absence of interfering parts. Another company uses a headlight, in the back of which is mounted a mirror, thereby combining the two accessories which heretofore had to be mounted separately. Still another concern mounts its electric lighting generator on the cooling fan, while a fourth combines the horn with the fan. The use of the magneto as a generator for electric lights is coming into favor more and more, the largest American manufacturer just having announced that in future models a slightly larger magneto will be furnished without extra charge, in combination with a complete electric lighting installation. The next two years will undoubtedly see many similar combinations, reducing the number of parts, the number of odd angles to the car, and the time and expense of assembling the car. The lowest priced cars probably will lead in this respect.

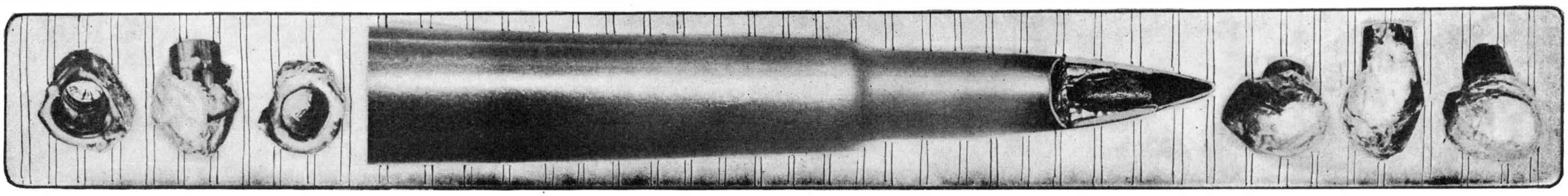
Dum-dum cartridges, all forbidden by laws of war. First three have soft point bullets with metal patches of varying length. No. 4 has a soft point Spitzer bullet.



No. 5 is a 250-grain Savage; 6, British "Mark IV," the original hollow point dum-dum; 7, copper tube expanding Spitzer, used for big game; 8, hollow nose sectioned to show form.

# Dum-dum Bullets

By Edward C. Crossman



Dum-dum bullets after firing.

Expanding Spitzer bullet sectioned to show hollow copper jacket that makes the bullet break up.

Dum-dum bullets after firing.

THE dum-dum charges on both sides take us back to the days of the Spanish war, when the same accusations were made. As a matter of fact, Spanish 7-millimeter cartridges could be produced with the point of the bullet sawed criss-cross with a hacksaw, but at that we doubt its being any more deadly than the ordinary bullet.

With the exception of the French, the belligerents in the present war use smokeless high-velocity rifles of small bore and, of course, firing jacketed bullets. These bullets are constructed of a lead core, with a tough jacket or skin over the outside, closed everywhere except at the base where the core is inserted. This very tough skin is made either of sheet steel, nickeled to prevent rust, or else of an alloy of copper and nickel of about the proportion of 20 per cent nickel to 80 per cent copper, and being thus merely German silver. Sawing the point off a sharp point bullet of this construction does not cause the bullet to break up in tissue, unless the cut is made far down the bullet.

All the nations engaged use practically the 0.30 caliber, although, of course, the cartridges vary considerably. No, they are not 30-30's, nor any relation to 30-30's, the 0.30-30 being an American game-shooting cartridge of considerably less power than a military cartridge.

Now early in the small bore, jacket bullet game, the British found themselves in difficulties with some hill tribe or other. These Afghans or similar East Indian Apache, were accustomed to rush British camps by the light of the stars, or sometimes by daylight, and brandish knives as large as *machetes* and as sharp as razors.

The first thing the British discovered about their new small bore acquisition in place of the good old 0.45 caliber Martini Henry, was that the new rifle would not stop an Afghan or other hill person, who really intended to keep coming. Several British soldiers were killed by hill men who, according to all the laws of warfare, should have been very, very dead. Drilling them with the 0.303 seemed merely to exasperate them. Therefore, in their hill arsenal of Dum-Dum, the British proceeded to evolve a new bullet for making good men out of hill men. They took the 0.303 bullet and removed some jacket from the point, exposing the leaden core. Then they tried it on some more hill men. The British troops reported that it was fine. No word was ever received from the parties on the other side. Thus arose the first soft point, metal-patched bullet, and on it was saddled the name of Dum-Dum from the little, obscure Indian arsenal that produced it. And so, every bullet from a small bore rifle, doctored up in any way at all, was yclept Dum-Dum, although it might use some other system for procuring expansion of the bullet. Also any wound that was unseemly large was promptly charged up to a dum-dum bullet, although it might just as well have come from a bullet ricocheting from rocky ground, or in these modern days from a sharp point bullet in its original tumbling act.

The British proceeded to change this dum-dum bullet around a bit, making it hollow nose, instead of exposing so much lead, but still designing it to expand and break up on impact. It was officially recognized and named, as we remember, the Mark IV, the British so naming every separate cartridge and rifle they ever produced.

They found it just as pleasing in Africa. They laid out Dervishes with it, and they stopped Matabeles and other members of the Zulu nation. With the last, particularly, the ordinary bullets proved ineffective. When an impi started for the British line, the members thereof kept on coming until physically unable to move on. The regular bullets were inadequate. We have before us a half dozen of the hollow nose bullets used by the British in the Matabele trouble.

At The Hague or Geneva Convention, we forget which, the British, with other civilized nations, signed compacts forbidding the use of expansive or explosive bullets. The bally heathen had nobody at the convention, which was a little tough on the heathen.

But the French, against whom the dum-dum charge was brought, have as clear a case of alibi as any small boy who could prove that he was stealing apples out of an orchard a mile away, when the melon patch was raided.

Exposing the lead of a patched bullet or giving it a hollow nose tends to make the jacket peel back and split up in ribbons, allow the lead to fly off in small bits, and the main body of it to flatten out or mushroom.

But the French use exclusively a bullet formed of solid copper-zinc alloy, no jacket, no lead, no soft metal to smear around regardless of what one does to the bullet. It could "dum-dum" about as easily as a piece of heavy copper wire. The German charges were disproved the instant we saw at whose door they had been laid. The French soldiers—some of them—in their ignorance might have sawed at the points of the bullets or cut them through, or otherwise fussed around with them. Instances of the sort are common in every army, including our own. But, regardless of the intent of the few scattered fools that might have done this, the effect was *nil*, because you cannot do anything to a solid copper-zinc bullet to make it more deadly.

Also, Germans protested because the French cartridges were poisoned. They found a ring of black stuff around the neck of each cartridge. I have one before me, and it is not a pleasing cartridge in appearance. I know of other cartridges I would select in preference were I planning to be shot—say the B. B. or 0.22 Short for choice. This black stuff turned out to be a waterproofing, and about as poisonous as Munich beer.

If the dum-dum charges had been leveled in later days of the war, and at the British, it might have aroused suspicions among those that knew the facts that the British had by mischance been shipped some of the old Mark IV hollow nose bullets, but I, for one, refuse to believe that they ever would use them deliberately.

As a matter of fact, consider the manifest stupidity, not to say childishness and lack of sportsmanship that lies back of all this dum-dum folly. Altering a bullet on a wholesale scale would result in inaccuracy, altered ballistics of the rifle, chances for trouble if the bullet broke up in the barrel as happens if the point of a solid jacket bullet is sawed off, and general trouble all round, not to mention the small job of altering a few billion rounds of cartridges urgently needed on the firing line. And, were all this done, the net result would be a few men killed that otherwise might have lived, a few wounds of far nastier type, and a few less wounded for the surgeons to patch up.

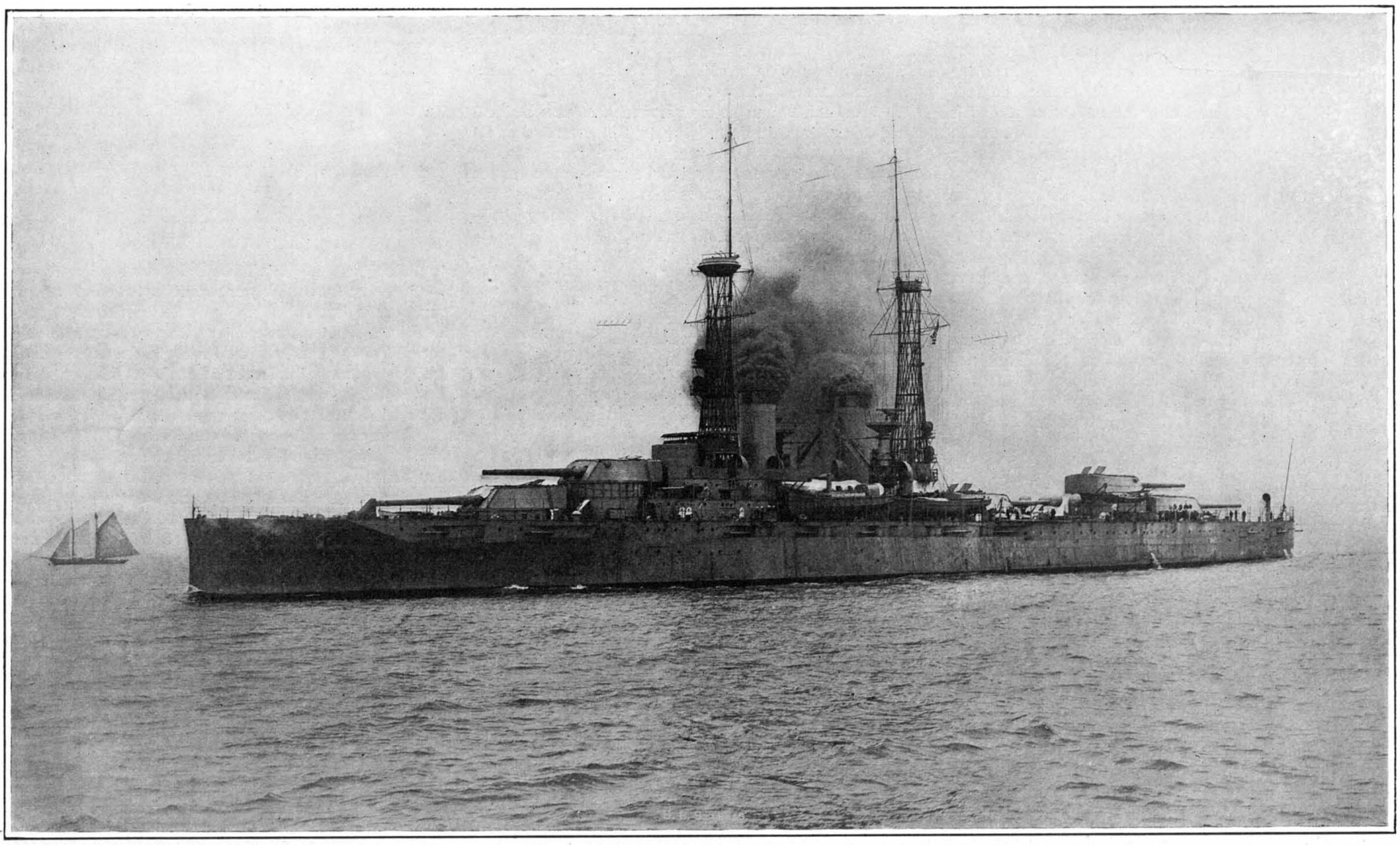
When a man is hit by any modern or old style bullet he usually quits. I speak now of civilized troops. The Russians quit before the tiny 0.25 caliber bullets of the Japs. The little 0.25 caliber bullets did just as effective work in the Balkans as the 0.30 caliber bullets. Once in a while a man might keep on fighting with a hole in him, but he is not worth while breaking all the laws of civilized fighting for, to say nothing of the trouble entailed in altering the bullets used.

Therefore, if you stop the advance of the enemy you've done all you can. The condition of his wounded does not interest the men on the other side. Nobody but a heathen would want to think of the wounded of the other side lying in agony from torn wounds of explosive bullets. Dum-dum bullets don't help to hit any more men, and it is hitting the men at all that is the difficult and the decisive thing in war.

On the other hand, the surgeons of both armies do find men badly torn, with slashing wounds that apparently never could be produced by anything but expanding bullets.



**Clip of British cartridges transfixed by a German bullet while in a soldier's bandolier.**



Copyright by E. Muller, Jr.

**Date,** 1913. **Tons,** 27,000. **Speed,** 21 knots. **Guns,** Ten 14-inch, twenty-one 5-inch. **Torpedo tubes,** 4. **Belt,** 12-inch.

**U. S. S. "Texas," the first of our battleships to mount the 14-inch gun.**

# An Analysis of Our Naval Standing—II

## Why We Are An Inferior Power

By George von L. Meyer, Former Secretary of the Navy

IT has been held that the possession of a sea-going fleet having rapidity of movement and the ability to keep the sea insures without doubt the transference of a hostile attack to some point at sea at a great distance from our home shores and an ability to maintain a free highway for American commerce under conditions where the submarine would be practically powerless. That is true only in the sense that battleships are, and may indefinitely remain, the controlling factor in any war in which the belligerents are separated by great distances of water, but it is not always feasible for a battleship fleet to leave home waters. The powerful fleet of British dreadnoughts is, so far as known, within a few miles of any point of the British coast. Its past or future vulnerability for German submarines is something that will not be known until long after the end of the present war.

The North Sea and the British Channel constitute a body of water whose coast lines, on all sides, are never widely separated. The location has given the submarine a safe field for action and has correspondingly limited the usefulness of the dreadnoughts, which are, in reality, doing no more than patrol duty. Our home waters would never offer an identical situation to a hostile fleet if we exclude the Caribbean Sea. But in order to retain the command over that sea a powerful fleet would be necessary. Therefore the ratio of submarines to capital ships must be maintained on the basis recommended by the General Board if we wish to consider ourselves safe.

In view of the increasing number of submarines, however, and the age of some of the older vessels, there is urgent need also for testing and wrecking docks that may be used for salving submarines of any size, docking submarines, and testing to determine resistance to external water pressure. Two docks of this description will ultimately be required for the Atlantic, and one each for the Pacific Coast Hawaii, Panama, Guam and the Philippines.

Two other types of auxiliary ships are required for the successful administration of the fleet—hospital and supply ships. The two hospital ships now borne on the navy list—the "Solace" and the "Relief"—are both improvised and small, and neither adapted to the service. They have done good service in time of peace in connection with subdivisions of the fleet, but the "Relief" is now *unseaworthy* and the "Solace" would be of limited value in time of war. To remedy this defect the General Board repeats the recommendation for the 1916 programme, as it again recommends an additional supply ship. One, authorized in 1913, is now under construction, but another is needed, because the four ships we have are improvised and were hurriedly bought and fitted in 1898 to meet the exigencies of the Spanish war. Upon the efficacy of the supply ships depends the efficacy of the fleet when it is away from home waters or its base. This question of supply ships has again been demonstrated in the present war, and though the source remains a secret it is known that the German system of supply has been marvelous. Up to the time of writing not one German cruiser was forced to intern or surrender because of lack of supplies. Some of these supplies, true, may have been obtained from vessels of the enemy, but I do not doubt for a moment that Germany (or any other power) has a perfect system of supply and the proper number of ships to do the supply work.

Two other important items should be considered; one relative to a floating dock and another for coaling stations.

Graving docks of 1,000 feet for both the Atlantic and Pacific, to accommodate newer and larger vessels, are necessary, to be located at places subject to later selection. But the construction of a floating dock of about 40,000 tons capacity is necessary. Such a dock is indispensable to float a battleship or cruiser that has been injured or wrecked or crippled on any part of our coast. The dock must be large enough and strong enough to hold the heaviest dreadnoughts. We have now only two floating docks, one in the Philippines and one at New Orleans. The latter will float a battleship of about 15,000 or 16,000 tons, although doubt exists in some minds as to whether it would be safe to float a 16,000-ton ship—the absolute limit of its capacity. Such a dock ought to be stationed on the Atlantic, although there was an element in Congress, when I first recommended this dock, that suspected a hidden motive. But if doubt existed then as to the desirability of such a dock, the present war has likewise demonstrated the value of this equipment, which forms a part of the German and British navies. One of the latest reports is that the "Audacious," the dreadnought which was rendered useless on the Irish coast late in October, is now supposed to be undergoing repairs, and these repairs are only possible because the huge dock was taken to the scene of the disaster.

We are likewise confronted with the necessity for large reserve supplies of coal. The navy lacks adequate coal and fuel depots at several important strategic points, notably Guantanamo, Puget Sound, and Pearl Harbor. Arrangements have been made to increase the capacity and facilities at these places as far as practicable with the funds that have been available from time to time, but a considerable additional appropriation for the purpose is necessary in order to achieve the desired result.

Without ample coal and oil storage capacity at the distant bases, and in the absence of a large merchant marine to insure a continuous supply of fuel, the activity and effectiveness of the fleet will be seriously, if not fatally, affected in time of war. An item of $500,000 would perhaps cover the requirements.

There has been a tendency in certain congressional quarters in favor of a general naval base located somewhere on the mainland of the Gulf coast. This plan has been taken up by the joint board of the Army and Navy, but its unanimous recommendation has been for a naval base on the Atlantic coast. But in order to consider this point we must disregard existing naval stations. The interests of the country and the interests of the Navy would be best served by the establishment of one first-class naval station with ample anchorage on the coast north of the Delaware, equipped for docking, repairing, and provisioning at least half the entire fleet, and one station of the same capacity at Norfolk, in Chesapeake Bay. This would be supplemented by a fleet rendezvous at Guantanamo with sufficient docking and repairing facilities to enable the fleet to maintain itself in that vicinity for considerable periods, but not for extensive repairs; an ample torpedo-boat base at Charleston; a supplementary torpedo and submarine boat base at Key West, and a station for the large reserve fleet at Philadelphia. The fresh water basin there is to be the port of the reserve fleet of battleships, and the department has been studying the system which will put these ships in such a condition that they will be ready at the shortest possible notice and at the same time will not deteriorate.

Now we must consider the personnel.

For the first time in many years the enlistment is up to the limit prescribed by Congress. The enlistment at

present is 52,667, or 4,612 greater than last year. This increase was made possible by recruiting to the additional authorized strength. It is estimated that about 90 per cent of the effective fighting power of the Navy is now fully manned. But one cannot hide the fact that although the numbers are recruited up to the limit allowed by law, we have only sufficient men to man in an adequate manner a portion of the vessels already built. At present three second line battleships, two armored cruisers, two third-class cruisers, twenty-one destroyers, three monitors, five submarines, one gunboat, three fuel ships, and two vessels of special type are in commission in reserve; that is to say, they have on board from 25 per cent to 50 per cent of the crews necessary to man them in case of war. There are also 6 second line battleships, 1 armored cruiser, one second-class cruiser, and 14 torpedo boats which are in the condition technically called "in ordinary." These vessels are manned from 10 per cent to 20 per cent of their regular complements—just enough to prevent them from *rusting to pieces.* Further, there are 3 second line battleships, 3 second-class cruisers, one third-class cruiser, one destroyer, two monitors, four torpedo boats, 6 gunboats, one transport, one hospital ship, one fuel ship, one repair ship and 11 converted yachts which are at present out of commission altogether.

To provide a proper complement for all vessels of the Navy which could still be made useful for war purposes would require an addition to the present force of about 18,000 men.

As things stand, building battleships or other warships without having an adequate force of men is equal to wasting money. For instance, a statement issued by the Navy Department recently reads that "theoretically, and on paper, the Navy possesses at the present time ten battleships of the first line and twenty-three battleships of the second line, but actually only the ten battleships of the first line and eleven battleships of the second line can be placed in commission for service because of the *shortage of men.*" The foregoing totals, however, do not agree with the official table showing the naval standing of the powers.

Whether or not the practice of taking the crews from the older ships to man new ships is a wise one is doubtful. It may be true that 800 men on a dreadnought of the latest type are as effective as 4,000 men on old battleships or old cruisers, but I am convinced that all serviceable vessels—regardless of their class—ought to be fully manned, and that for every additional warship added to the fleet an adequate number of enlisted men should be provided for. If men must be taken from one old ship to man a new one, the change ought to take place in those instances where the ship is actually retired and condemned as unfit for further service.

The General Board, in its latest report to the Secretary of the Navy, states as follows:

"The General Board cannot too strongly urge upon the Department the necessity of using its best endeavors to carry out the repeated recommendations of the General Board, made from year to year, to provide the fleet with a personnel, active list and trained reserve, equal to the manning of the fleet for war. In the opinion of the General Board this is a matter of even more serious import than that of construction, for it cannot be too often repeated that ships without a *trained* personnel to man and fight them are useless for the purposes of war. The training needed for the purpose is long and arduous, and cannot be done after the outbreak of war. This must have been provided for long previous to the beginning of hostilities; and any ship of the fleet found at the outbreak of war without provision having been made for its manning by officers and men trained for service can be counted as only a useless mass of steel whose existence leads only to a false sense of security.

"The strength of fleets is measured too often in the public mind by the number and tonnage of its material units. The real strength of a fleet is a combination of its personnel—with their skill and training—and its material; and of these two elements the more important—the personal—is too often forgotten and neglected in making provision for our fleet."

This last paragraph is worthy of attention not only by Congress, but all the people. We alone of the naval powers provide no trained reserves. We trust to the filling of the complements of our ships by untrained men recruited after war is imminent or declared!

Of course, no nation in time of peace keeps all the ships of its navy fully manned and in full commission. But all the leading nations except the United States provide an active list, officers and men, sufficient to keep the best of their fleet in a material condition for war; and in addition a trained reserve of officers and men sufficient to round out the complements and fully man every serviceable ship of their navies, and also furnish a reserve for casualties. Thus every nation except ours is prepared to mobilize its entire navy, by order, with officers and trained men.

Congress, however, will not be officially acquainted with the fact that the General Board is earnestly seeking a greater personnel list.

Yet the need of more men is a serious one. The requirements are as follows:

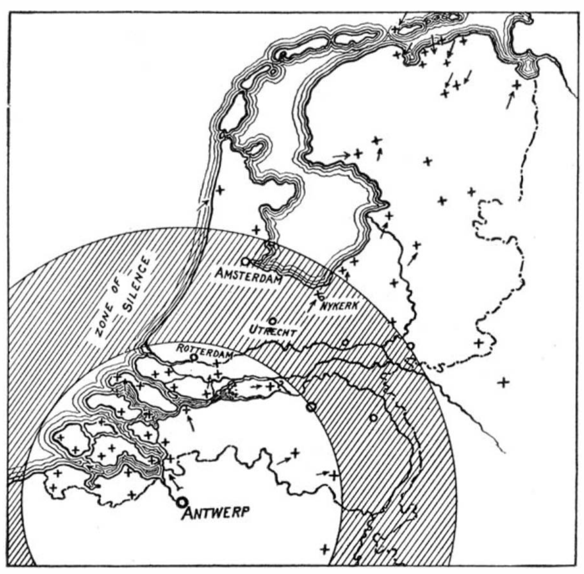
1. Provision for an active personnel, officers and enlisted force, capable of keeping in full commission all battleships under fifteen years of age from date of authorization, all destroyers and submarines under twelve years of age from authorization, half of the cruisers, all the gunboats and all the necessary auxiliaries that go with the active fleet.

2. To expand the active personnel with the expansion of the fleet in the proportions indicated in the preceding paragraph.

3. Taking immediate steps to form a national reserve of trained officers and men, and that his work be pushed until this reserve in connection with the naval militia has reached the point where, combined with the active list, it will be possible to man the entire fleet with war complements and furnish an additional ten per cent for casualties.

If we could get a reserve of 50,000 men, half of whom have been in the Navy and the other half in the mercantile marine service, either on the Lakes or along the coast, then we would have a personnel emergency reserve which would be of great value in time of need. Our present naval militia is insufficient, as it numbers about 7,000 men. We need a reserve to make up the personnel deficiency.

Let us not forget that this country possesses potentially a well-trained and capable naval reserve, but it is unorganized and it is at least 10,000 men short. Plans ought to be made to organize this body of reserves that would make of it an effective reserve in time of war. There are about 30,000 of these former sailors, men fit by physical strength and experience both to officer and man naval auxiliaries, as well as to return to their places as gunners, gun pointers, and other positions on our warships.




**The shaded area marks the zone in which the bombardment of Antwerp was inaudible.**

We have more vessels in commission than most of the nations which give higher rank to their officers, yet when our fleets enter foreign waters our naval officers are compelled to yield precedence to ranking officers of smaller nations. This is not an indignity to the man so much as to the United States. It is not a question of our naval officers, as individuals, being placed in inferior positions when they meet the fleets of other nations. It is that in the eyes of other nations we put ourselves in the position of *an inferior power.*

And another deficiency worthy of notice is the fact that it would be practically impossible for the United States Navy to make any strategic move outside of American waters unless it first obtained, by purchase or otherwise, British admiralty charts to insure safe navigation. How soon the United States will become independent of chartmakers I do not know, but the fact stands that we lack a very necessary item.

There has been a great deal of comment about the unreadiness of the fleet to-day. During the past two years maneuvers and battle practice of the fleet as a whole have been greatly curtailed. The last mobilization, in the full sense of the word, was during the last Administration in October, 1912, when 31 battleships, 4 armored cruisers, and 88 smaller vessels, manned by 1,300 officers and nearly 27,500 enlisted men, participated in the review. Since then the custom of annual mobilization has been abandoned. Why? Because the present Administration has required the use of battleships for duty which could have been performed equally well by gunboats and small cruisers. In addition, the shortage of men is also seriously interfering with the annual maneuvers so necessary for the efficiency of the fleet. Vessels for such service are almost rusting away while "in ordinary," and the battleships suffer because emergency duty prevents their mobilization and proper drills.

Are not the foregoing circumstances worthy of attention? Are there not many defects which should be eliminated? Is not the present policy a costly and roundabout one?

## Zones of Silence

**By W. J. L. Kiehl**

PROF. VAN EVERDINGEN has published the preliminary conclusion arrived at in the Meteorological station of Utrecht about the area in the Netherlands where the bombardment of Antwerp was audible. More careful study has, however, to be given to the matter before it can be understood in all its phases, for instance the bearing thereon of the local weather conditions have still to be more especially investigated. The broad conclusion that could at a glance be deduced from the reports that came in from various places in Holland after each place where the bombardment had been heard had been marked on a map (see accompanying diagram) have absolutely confirmed the theory of the German scientist, Dr. Von dem Borne, who suggested that the phenomenon of zones of silence correspond to a similar phenomenon in light, which produces the well known *fata morgana* of the desert. According to this theory the sound waves which are thrown upward do not lose themselves in infinity, but, after reaching a height of from 60 to 80 kilometers (37 to 50 miles) according to the greater or less density and dampness of the atmosphere are thrown back again or reflected toward the earth.

The area over which the sound of the bombardment was directly audible was a very wide one, about 85 kilometers in radius. Then follows a zone of silence of 60 kilometers broken only in one place (see the small cross near Nykerk on the map). What local atmospheric condition caused this exception has not yet been ascertained. Beyond this zone the sound again became audible and the direction from which the observers perceived the sound is given by the small arrows on the map. It will be seen that in the extreme north of the province of Groningen the sound of guns was heard coming from the northeast, and upon investigation it proved that simultaneously with the bombardment of Antwerp, October 7th to 9th, gun practice at Borkum was going on and also at Meppen, where Krupp gun ranges are situated. This group of crosses will, therefore, have to be eliminated. It is interesting to note that at Utrecht itself the sound of the bombardment of Antwerp was not heard, but when, later on, the fighting line in Belgium was removed to a distance of 200 kilometers from Utrecht the sound of guns was plainly discerned, both by Prof. van Everdingen himself and others of the observatory.

Prof. W. Meinardus of Munster in Westphalia happened to hear of the investigations carried on at Utrecht and sent Prof. van Everdingen a clipping from the *Münster sher Anzeiger* of October 10th, in which appeared letters from persons in places some 180 kilometers distant from Antwerp, to the east and northeast, who not only distinctly heard the sound of guns, but were able to distinguish the difference in sound between the report of the 42-centimeter guns and others. He offered to collect further material upon this matter in Germany and send it up to Utrecht. This offer was gladly accepted, for, in this way, it may be possible to determine the width of the outer sound area.

Prof. van Everdingen intends to publish the results of further investigation later on.

## The Current Supplement

THE issue of the SCIENTIFIC AMERICAN SUPPLEMENT for April 17th, 1915, No. 2050, is most valuable in the variety and character of the matter it contains. There is an interesting account of the earthquakes and volcanic eruptions of Sakurajima, in Japan, showing their connection with other disturbances in this region. Testing the Sensibility of Plants is a valuable summary of the remarkable investigations by Prof. Bose, which have opened up an entirely new field in plant physiology. There is an interesting account of the zoological achievements of the Roosevelt-Rondon Expedition in South America by one of the scientific party. Wireless Transmission of Energy is an unusually clear and complete exposition of a subject of growing importance, written especially for the general reader by a leading authority. The Uses of Light in the Treatment of Disease adds much to our knowledge of the effects of different kinds of light. An English authority on aeronautical subjects reviews many of the important doings of the airman on both sides in the European strife, with comments on the results accomplished. There are articles on printing for the blind, German railways in the war and various other matters.

## Teaching Defective Children

### The Remarkable Experiment of Columbia University in Educational Psychology

**By A. M. Jungmann**

A SERIOUS problem in educational psychology is that of developing the mental faculties of exceptional or atypical children. Up to within recent years mental defectives among children were looked upon as hopeless and very little was attempted in their education. To-day, however, it is generally recognized that many forms of defective mentality are amenable to treatment along lines evolved through a better comprehension of those branches of medical science known as psychiatry and neurology.

An interesting experiment in the education of exceptional children is now being carried out in Columbia University. A class of atypical children has been formed in Speyer School, a model elementary school used for experimental purposes in connection with Teachers College. Psychologists recognize that the training of exceptional children must differ from the training of normal children in that each child requires individual study and the instruction it receives must be particularly suited to its requirements. In order that the greatest possible progress be made by the class as a whole the number of pupils has been restricted to ten children, thus permitting each child to receive the maximum amount of attention from the teachers and preserving, in all essentials, the individuality of each student.

The examination of the children who were admitted to the class was conducted by Dr. Louis E. Bisch, who has been very successful in the treatment of atypical children, and Dr. Naomi Norsworthy, Associate Professor of Educational Psychology. Before acceptance each child is thoroughly examined physically and mentally. Absolutely hopeless cases are not accepted. In his mental examination Dr. Bisch employs the Binet-Simon measuring scale for intelligence, the Yerkes-Bridges "point scale" and the Ziehen intelligence test. In the recognition of mental deficiency each of these tests has certain peculiar advantages. The point scale was designed by its authors with a view to improving the Binet measuring scale of intelligence. The test devised by Prof. Ziehen of Berlin University, has been used with highly satisfactory results in the psychiatric and neurologic clinic of that institution.

The Binet-Simon test has the advantage of instantly appealing to the child. Practically all children like to look at pictures, and if the examiner begins by asking the child to look at the pictures used in the test the child is at once placed at ease and will respond to the questions in a natural manner. It is essential that the examiner gain the confidence of the child. The questioner must assure himself that the child is entirely at ease if successful results are to be obtained. The child should look upon the examination not as an examination, but as a game which he takes pleasure in playing. The Binet and Simon tests are arranged to determine the mental status of children from three to fifteen years of age. If a child responds successfully to the tests arranged for its age it is probably normal so far as its intellectual development is concerned. But if it can succeed only in the tests arranged for younger children, it is backward. For example, a child of ten who could not succeed in the tests for its age, but who could successfully answer the questions in the tests arranged for a child of seven, would be three years backward in mental development. Children who are three or more years backward are looked upon as being mentally defective.

Binet has found that all children are not developed evenly. So he has determined, in estimating his results that a child has the mental development of the highest age for which it has successfully passed all the tests. Binet has also established that when the child's intellectual level has been obtained, it is to be advanced a year for every five higher tests in which it has succeeded in and two years for every ten tests successfully withstood.

A child of three should be able to comprehend spoken words and to answer simple questions by a gesture. Ask a child of three, Where are your eyes? and it should immediately point to them. A child of three should be able to repeat sentences of six syllables, but not ten. Figures, being more difficult than words because they do not convey any meaning to a child of three, are limited in the test to two, such as 6-4. When shown the pictures which Binet uses in his tests a child of three will enumerate the objects; it is not possible for him to describe any of the action in the pictures.

At four years a child should know whether it is a boy or a girl, but at three it would not be able to make the distinction. At four a child should be able to repeat three figures, be able to tell which is the longer of two parallel lines and be able to name familiar objects when they are displayed.

Among the tests at five years of age is the comparison of weights. A five-year-old child is able to tell which is the heavier of two blocks equal in size and appearance, but differing in weight. At five all children succeed in counting four. At three no child can count four, and at four only about fifty per cent of the children tested have been able to do so.

At six years a child should distinguish between morning and afternoon, should be able to define known objects and execute three simultaneous commissions. At six Binet believes that a child's esthetic perception is sufficiently developed for it to differentiate between beauty and ugliness. For this test Binet employs a picture of six heads of women in three pairs, one of which is pretty and the other ugly or actually deformed.

At seven a child should be able to count thirteen pennies; describe the pictures used in the test for three year mentalities, instead of simply enumerating the objects; point out what is lacking in unfinished pictures and name four colors.

By reason of this careful marking of each phase of the development of the human mind between the ages of three and fifteen years the Binet-Simon scale is regarded as an accurate means of measuring intelligence. But with all its advantages, Dr. Bisch has found it desirable to supplement the Binet-Simon with the Ziehen and Yerkes-Bridges methods, together with other psychological and psychiatrical procedures, in examining and classifying the atypical children admitted to the Speyer School class.

As an aid to classification Dr. Bisch has compiled the following tentative table setting forth the causes of abnormal mentality:

1. *Precocity* (*A*) congenital, (*B*) due to training.
2. *Retardation*, caused by (*A*) defective teeth, (*B*) errors of refraction, (*C*) adenoids and tonsils, (*D*) unfavorable environment, (*E*) malnutrition, (*F*) irregular school attendance (truancy, wanderlust, disease, etc.), (*G*), epilepsy, (*H*) syphilis, (*I*) tuberculosis, (*J*) sense deprivation, (*K*) gross physical handicaps, (*L*) speech defects, (*M*) neuroses and psychopathic personalities, (*N*) chorea and habit spasms, (*O*) rickets, (*P*) adolescence, etc.
3. *Arrested Development* (Resulting in Amentia), caused by (*A*) trauma, (*B*) meningitis, scarlet fever, diphtheria, etc., (*C*) epilepsy, (*D*) syphilis, (*E*) neurological condition, (*F*) adolescence.
4. *Amentia*, Idiopathic Cases (*A*) idiocy, (*B*) imbecility, (*C*) moronism (Congenital).

Special Types, (*A*) hydrocephalus, (B) microcephalus, (*C*) cretinism, (*D*) mongolism (*E*) Little's disease, (*F*) amaurotic family idiocy, etc.

5. *Moral Deviation* accompanied by (*A*) apparently normal intellectuality, (*B*) retardation, (*C*) arrested development, (*D*) congenital amentia, (*E*) adolescence, (*F*) insanity.
6. *Insanity*, (*A*) dementia praecox, (*B*) manic-depressive psychoses, etc., (*C*) episodes in constitutional inferiority, (*D*) following epilepsy, (*E*) simple dementia.

Each pupil in the class is the subject of careful individual study and observation, and his progress is recorded from day to day and filed with the record of his history, mental, physical and family, up to the day he was admitted to the class. The progress of some of the children has been more marked than others, but all have shown a decided improvement. The children are learning self government and self care, which raises them from a state of complete dependence to that of independent usefulness to a degree which would have been impossible fifty years ago.

The importance of this branch of education will become apparent when it is considered that out of the 20,000,000 school children in the United States it is estimated that 75 per cent are defective. Many of the defects from which these children suffer are minor and will yield readily to treatment. But if they are neglected the result is that the mental development of the child is inevitably retarded. A slight physical defect which can be readily eliminated by simple surgery or medical treatment will be the cause of a certain amount of strain which is bound to react on the nervous organism of the child and produce restlessness and a lack of the power of concentration. Erratic, nervous children may be brought to a normal condition through hygiene, medication, psycho-analysis or hypnotism. The tendency to extreme nervousness, if not eradicated during childhood, frequently develops into a serious mental disorder in later life. There is nothing a community can so ill afford as human waste. If the experiment in the education of defective children at the Speyer School points the way to the conservation of human beings who ordinarily would be a dead weight on society it will be of inestimable benefit to the country.

## Disinfecting Railway Cars

SEVERAL years ago experiments were made in Russia in disinfecting railway cars by the use of steam and formalin, the results of which have only recently been announced. To start with the temperature inside the car is raised to 65 deg. Cent. by the admission of steam, which takes from fifteen to twenty minutes, according to the size and style of car, and the formalin is sprayed by pressure generated by an oil motor. A mixture of formalin and ammonia was also tried. The results as regards the distruction of germs of plague, typhoid, tuberculosis, etc., were fairly satisfactory, but it was found rather difficult to get a uniform temperature, and the vapors injured some of the paints used in the cars.

## Selenium in the Production of Colored Glass

**By Samuel Wein**

SELENIUM, produced to the extent of about 11,000 pounds annually, has a very limited practical use which is mostly confined to the manufacture of red glass and red enameled ware. Ever since the patent granted to F. Welz (Ber; 25 page 819) on the process of coloring glass by means of selenium, very little has been published. It is for this reason that this paper has been written giving the actual formulæ now in use by the various glass companies both in the United States and abroad.

A great advantage in the use of selenium lies, first, in the fact that it is not necessary to reheat the glass after it has been made (which, by the way, is the usual process), and second, in the fact that its cost is much less than that of gold chloride or other chemicals used.

Welz used selenium or a compound of selenium and cadmium sulphide for the production of rose, red, and orange colored glass (*Eng. Min. Journal*, December 18th, 1897, page 731, and SCIENTIFIC AMERICAN SUPPLEMENT, January 1st, 1898, page 18,345); on investigation it was found that Welz's formula was not satisfactory.

The formula was soon corrected, and is made as follows:

| | |
|---|---|
| Sand | 100 kilogrammes |
| Soda | 20 kilogrammes |
| Potash | 8 kilogrammes |
| Lime | 7 kilogrammes |
| Borax | 0.5 kilogrammes |
| Cryolite | 13 kilogrammes |
| Selenium | 300 grammes |
| Cadmium sulphide | 700 grammes |
| Sulphur | 230 grammes |

The result of the above batch is a beautiful coral-red corresponding to Kaiser-red glass.

Similarly, for a transparent yellow-red glass:

| | |
|---|---|
| Sand | 100 kilogrammes |
| Soda | 12 kilogrammes |
| Potash | 10 kilogrammes |
| Minium | 20 kilogrammes |
| Limestone | 10 kilogrammes |
| Selenium | 200-300 grammes |
| Uranium oxide | 60 grammes |

The writer would suggest the use of selenites or selenates, as these salts are more suitable than metallic selenium, since they are more stable in the heat of the furnace, and are, in consequence, less likely to become lost through volatilization and oxidation.

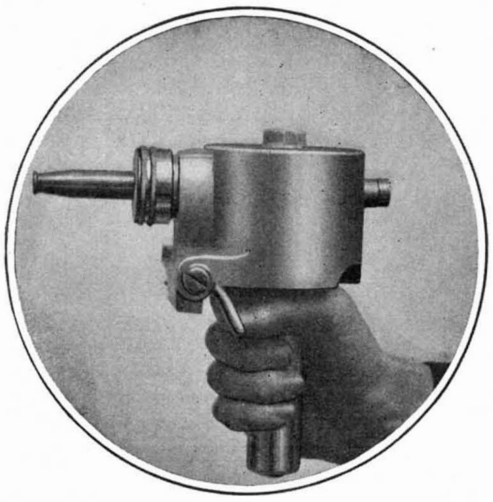
Glass decolorized by means of selenium possesses an unusual clearness and brilliancy. The use of selenium as a decolorizing agent (sodium selenate is generally used) is claimed in German patents, Nos. 63,558, 75,565, and 88,615. Selenium manganese is now being marketed in the United States as a glass decolorizer.

## Back Numbers of the Scientific American Supplement

WE beg to advise our readers that we have discontinued selling numbers of the SCIENTIFIC AMERICAN SUPPLEMENT dated earlier than January 1, 1914. We removed the first week in April to the Woolworth Building, New York city, and the change in our offices precluded the carrying of issues of the SUPPLEMENT extending over a period of nearly forty years. It was, therefore, necessary to turn over this portion of the business to someone who has space for carrying so large a stock. The H. W. Wilson Company of 39 Mamaroneck Avenue, White Plains, N. Y., have been chosen to take care of our back number business. They have the complete stock and are ready to supply any of the back numbers at the standard price of 10 cents. We, therefore, request that, in future, all orders for SUPPLEMENTS be sent direct to the H. W. Wilson Company instead of Munn & Co. Please do not order SUPPLEMENTS on letters ordering subscriptions for the SCIENTIFIC AMERICAN or the SCIENTIFIC AMERICAN SUPPLEMENT or books, or containing any other matters.

## To Old Readers of the Scientific American

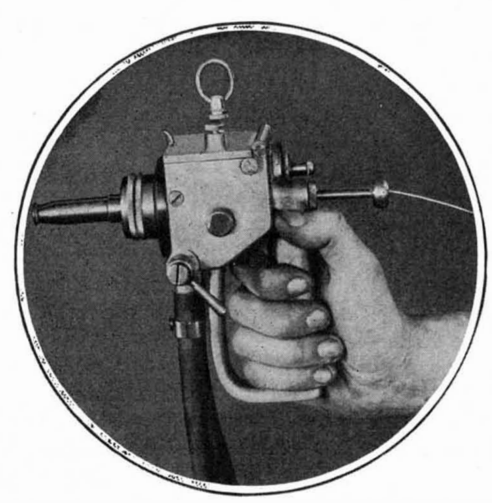
THE June number of the SCIENTIFIC AMERICAN will commemorate the seventieth anniversary of the house of Munn & Co. In that number we wish to give a history of the SCIENTIFIC AMERICAN. Old readers and subscribers who visited the editorial offices in the past are requested to send us their impressions, anecdotes, experiences, and the like. Indeed, any information at all relating to the old offices on Park Row will be gratefully received by the Editors.



New form spraying pistol.

# Development and Perfection of Schoop Metal Spray

## The Improved American "Pistol"



Old form spraying pistol.

At a manufacturing establishment in New England there is now to be seen the operation of the spraying of metal, a phenomenon so new that the precise nature of the action is not yet understood, nor has there been stated as yet other than the merest outline of its practical possibilities. The apparatus is a development of forms already described in the Scientific American, and save these articles but little else has been published as yet in English.

The apparatus is an atomizer, but instead of a spray of perfume or of disinfectant drawn from a reservoir of the liquid, the reservoir here is a solid wire and the spray a shower of metal particles, which will form a coating of the metal upon any object placed a few inches from the nozzle of the atomizer. The process is the invention of M. U. Schoop, a Swiss engineer, the fundamental patents are not yet two years old, and there has been steady improvement of the apparatus in the laboratory of the inventor and in this country till it has reached the practical stage that is here to be described.

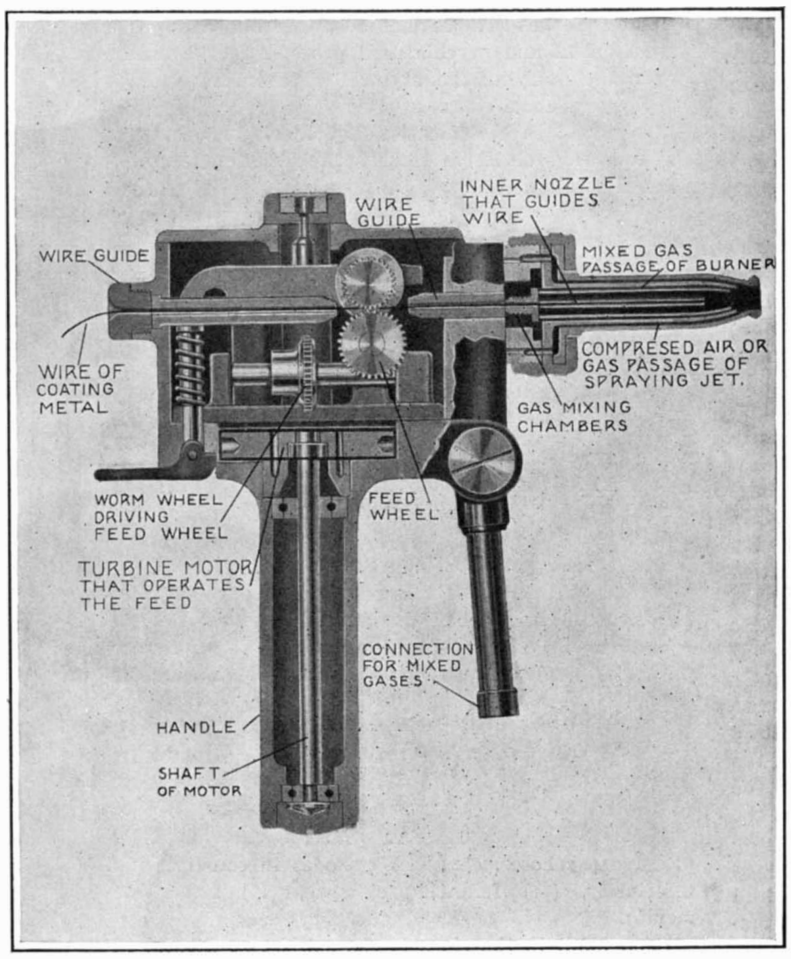
"Pistol" is a very apt name for the atomizing device. It has a grip and a muzzle, but the magazine portion is rather large relatively. The pistol is a mechanism that straightens the metal wire, feeds it a speed which may be regulated at will, concentrates upon the wire the gases that are to melt and the spray that is to atomize it, and the whole device, by means of the grip, may be directed to any portion of the object to be treated.

In its passage through the pistol the wire is physically unaltered, but on its emergence from the inner tube of the barrel the transformation takes place. It becomes a stream of metallic particles carried by a current of air or gas, just as the liquid in the atomizer becomes a similar stream of liquid drops. Interesting and curious as this transformation proves to be, it is less astonishing than the results, for just as one finds the liquid fixative in a film on the drawing, so one finds a coating of metal on the surface subjected to the Schoop metal stream. This is smooth and compacted, and if there is opportunity for it so to affix itself, its particles will be driven into the minute crevices of the object treated, permanently there to remain and cling.

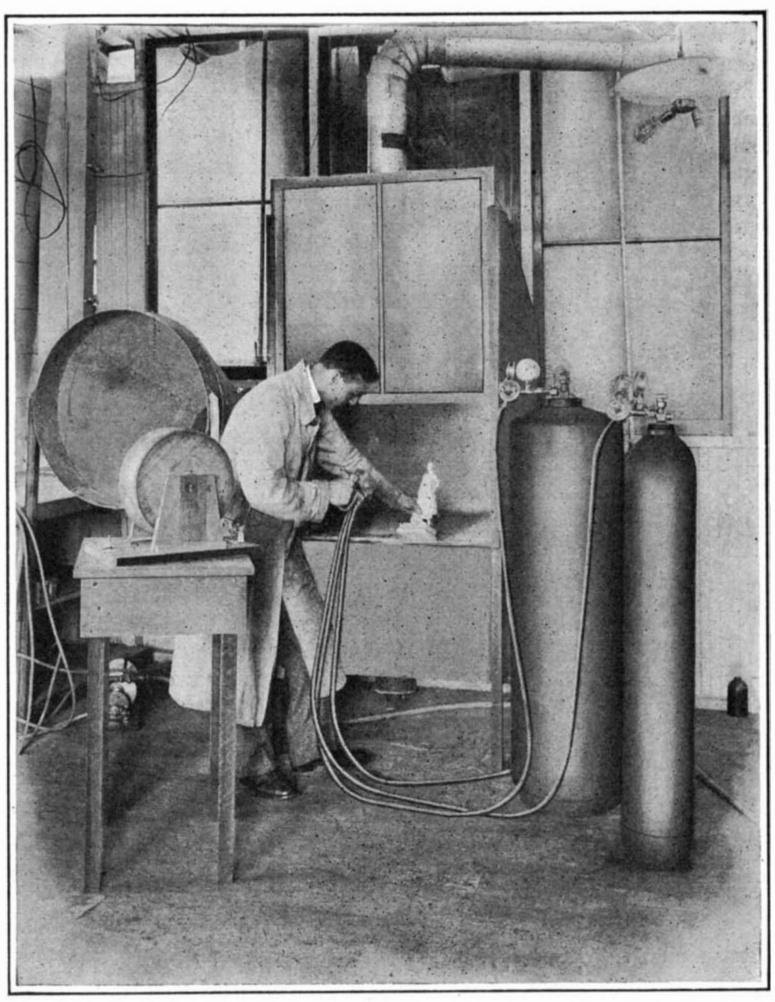
Metals and alloys alike are subject to the same strange technique. Lead, tin, zinc, aluminium, copper, brass, bronze, and German silver have been tested out quantitatively, while gold and silver, though amenable to the process, have not yet furnished their full data. The film that is deposited by the spray may be from 0.001 inch upward, and is firm and continuous.

Some of the accompanying phenomena are likewise of interest. While the temperature at the apex of the cone of spray may be from 700 deg. Fahr. to 2,000 deg. Fahr., at the distance of only four or five inches, delicate materials that are combustible may be coated with the metal but will not be burned. Matches held in the spray are metalized but not ignited, tissue paper can be surfaced with metal, while brass issuing at 1,550 deg. Fahr. has been deposited on silk without injuring its texture.

It is the barrel of the pistol that is responsible for the strange results, for as has been said, the internal mechanism is devoted to straightening the wire and regulating its delivery. There are really three concentric barrels and the innermost is that through which the wire issues. The second tube conducts to the place selected for the melting point a jet of mixed gases under pressure, in fact a blow-pipe; while the outer annulus delivers compressed gas which furnishes the velocity necessary for the spray. The blow-pipe mixture may be coal gas, water gas, acetylene, hydrogen, etc., with air or oxygen for its stimulation, while the spraying jet may be carbon dioxide, nitrogen, air, steam, etc. The temperatures, pressures, and mixtures are factors to the techniques for different metals, so that accurate gages, reducing valves and the like are portions of the apparatus. Likewise the pressure and velocity of the air jet must be variable to suit the conditions required by the different metals.




Section of metal spraying pistol, showing mechanism.



Operating the metal spraying pistol.

There must be, moreover, the chance for adjustments in the barrels to accord with the diameters at which the wires are used, and relative changes are necessary in the gas and air jets. Then there must be the possibility of regulating the feed-speed of the wire, which is moved forward by a motor driven by compressed air.

So far as anyone yet can definitely analyze it, the operation is this: The blow-pipe performs its duty of melting the wire. The spraying jet has two offices: by its expansion and consequent appetite for heat it keeps the muzzle of the pistol cool; and by its velocity, which may be up to 3,000 feet a second, it entrains a stream of metal. This is in minute particles, either in the plastic state or molten. Some may perhaps be gaseous, surrounded by a protective, reducing atmosphere. This is the cone that is moving with great velocity toward the object treated.

There is this anomaly, that within four or five inches of the point of origin of the melted metal, with the consequent high temperature, delicate laces and paper, and even matches, may be placed without burning them and the hand may be held there for a moment. This is plainly a phenomenon different from that when the foundry man passes his finger through the jet of molten iron running from the furnace. In the latter case it is believed that the moisture of the skin saves it from harm, but such an explanation does not serve with the sprayed metal.

The suggestions here are that the spraying medium is enormously greater in volume than the infinitely small particles that it is carrying. It is, moreover, still expanding and seizing heat, so that, relative to the particles, the cone is cool. But, while the cone must deprive the particles of some of their heat, it seems certain from the results that they do not impact upon the object treated in the form of droplets, for if they did, they ought to rebound. For the present, the only explanation to give is that there appears to be an abnormal physical condition, and that on account of the heat of the collision the particles pass into a vapor which at once condenses on the relatively cold receiving body. There is formed on this a solid, homogeneous mass or film, hammered by the succeeding particles; altogether a curious

(*Concluded on page 368.*)

# Measuring One Twenty-Millionth of an Inch

## The Finest and Most Sensitive Measuring Instrument Known to Modern Science

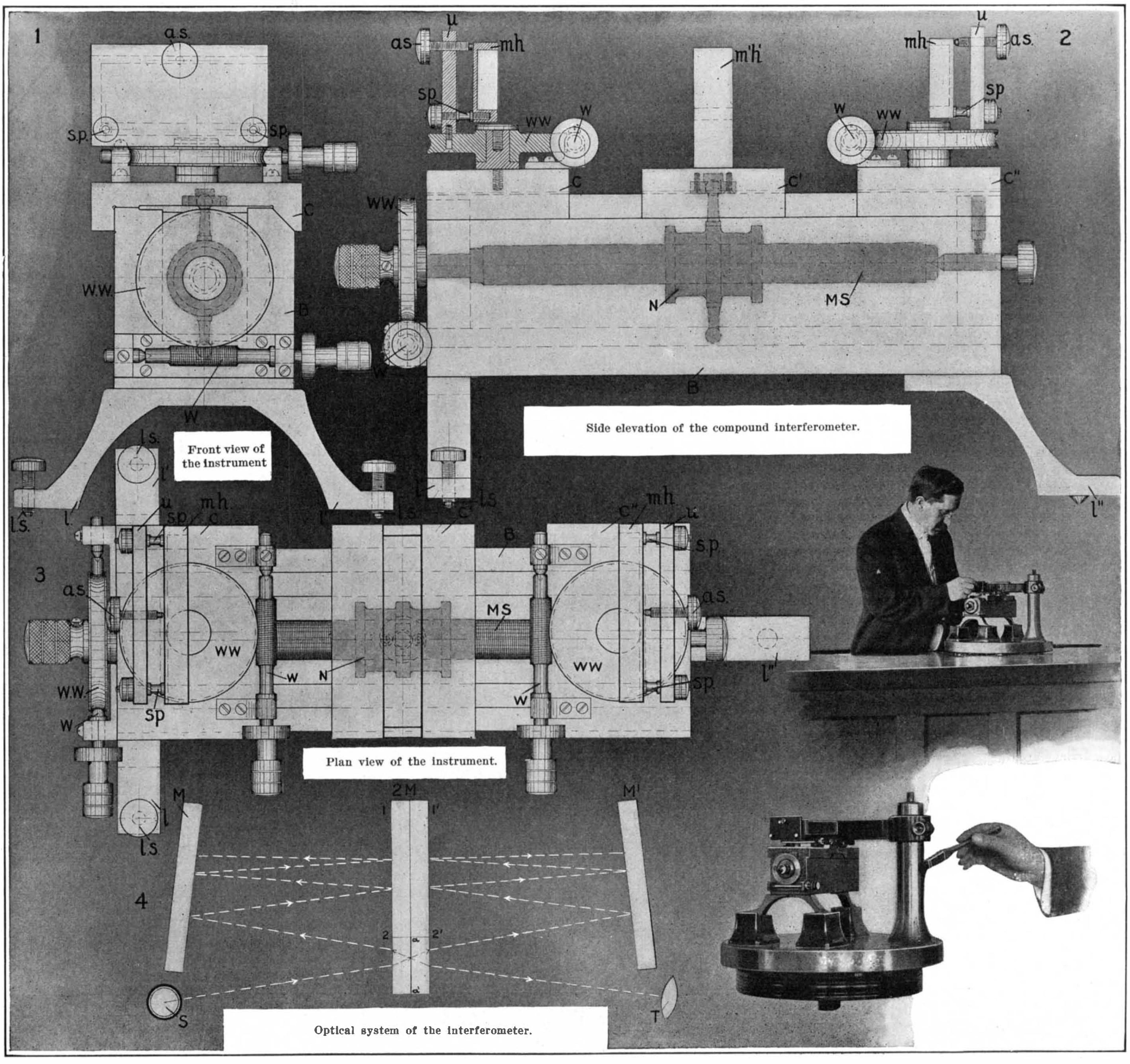
By Ernst Keil

THE inventions originated in the physical laboratories of educational institutions have contributed an immense part to the wealth of the world. The physicist relies upon the science of exact measurements to interpret the answers he receives to questions put to nature, and all the researches undertaken in physical laboratories have been made by performing measurements alone. There is not one, no matter how complicated, that in its final analysis could not be reduced to the three fundamental quantities of either *time*, *mass*, or *length*.

To carry out these measurements then necessitates the use of instruments with which to perform such measurements. In the early days of the laboratory the instruments were crude, but it did not take long to explore entirely the field within the range of those crude instruments and as necessity is the mother of invention, we find that as the need for better instruments was felt, skilled and ingenious men produced them.

The exact measurement of time has for ages received the close attention of the most skilled workers; the accurate determination of mass or weight has kept the physicist and the skilled instrument maker hard at work for many years, but the most difficult problem the physicist and astronomer had to face was the accurate determination of length or distance, whether that be along a straight line, the subdivision of a circle or the expression of an angle. To perform the most delicate and very finest measurements in determination of length, the physicist had for many years only one instrument at hand: the compound-microscope. It has played a very important part in scientific investigations, and had it not been for it many of the discoveries, the results of which we use so freely in our life to-day, would not have been possible, and yet, many problems lay beyond its range. The limitations of the microscope are adjusted by the fact that we employ light when measuring with this instrument and the waves of light are just so fine. It can be proved mathematically as well as demonstrated in a popular way that, when objects are smaller than one half wave-length of light, the microscope is absolutely unable to serve us. If we employ sunlit objects smaller than 1/80,000 of an inch they cannot be studied with it, and two objects which are closer together than 1/80,000 of an inch appear in the compound microscope as one.

The fact that the length of light-waves limited the magnifying power of the compound microscope made it again an absolute necessity for the physicist to go to work and devise an instrument that could overcome this lack of power, if physical investigation was not to stop in this direction. In due time two physicists in Cleveland, Ohio, Profs. Michelson and Morley introduced a new and most useful instrument, and they named it "*interferometer*." This new instrument consisted principally of a system of optical mirrors arranged in such a way as to let the waves of light of a suitable source pass between and through them, the waves in the course of their travel being divided and reflected a certain number of times, thus making it possible to measure objects 10 times smaller than the best compound microscope would allow us to do. This form of interferometer opened up a vast field of research investigations, and it has been used with excellent results in many physical and astronomical investigations. Unfortunately even this instrument has its limits of usefulness and there are scores of important problems awaiting investigation which lie way beyond its range. It was Prof. C. W. Chamberlain, head of the physics department of Denison University and now president of this institution, who invented the *compound interferometer*, the instrument that enabled the scientists at one stroke to measure a distance as small as 1/20,000,000 of an inch. This instrument will in all probability be the most delicate measuring instrument




Front view of the instrument

Side elevation of the compound interferometer.

Plan view of the instrument.

Optical system of the interferometer.

**Construction of the compound interferometer. One of the photographs shows Prof. Chamberlain adjusting his instrument, the other a test of the sensitiveness of the apparatus.**

of its kind for many years to come. It is next to impossible for a human mind to realize the smallness of the distance measurable with this marvel of an instrument. It is an instrument 40 times as powerful as the Michelson-Morley interferometer, or 400 times as powerful as the most perfect compound microscope. We can probably form a better picture if we use some comparisons:

This 1/20,000,000 of an inch is the apparent size of the head of an ordinary pin, viewed at a distance of 227 miles; or the size of a silver dollar, viewed at a distance of 9,000 miles; or the size of a human face, viewed at a distance equal to twice the circumference of our mother earth.

Details of construction may be seen in the accompanying line-drawings. Fig. 1 shows a front view, Fig. 2 a side view, and Fig. 3 a top view of the compound interferometer. The bedplate *B* rests on three legs, *l*, *l'*, *l''*; two of the latter are provided with fine-motion leveling screws *ls*. The bedplate *B* carries on its top on suitably shaped ways the three carriages *C*, *C'*, *C''*, and the latter carry the optical system of the instrument. The mirror holder *mh* is mounted on the upright *u* by means of the two steel-posts *sp*, the latter serving as springs to be operated by the micrometer adjusting-screw *as;* the holder *mh* and the upright *u* are fastened to the worm-wheel *ww* and this in turn finally to the carriage. The worm-wheel *ww* is provided with a worm *w* to move the mirror about its horizontal plane; the micrometer-adjusting screw *as* with the two steel posts acting as springs, allows the mirror to be moved a small fraction in the vertical plane; these movements are necessary, as we soon shall see, for the adjustment of the instrument. The middle carriage *C'* carries on top nothing but the fixed mirror holder *m'h'*. Inside of the *U* shaped bedplate *B* is a fine micrometer screw *MS* with nut *N* located to transmit a linear motion to either one of the three carriages *C*, *C'*, *C''*. The head-end of the micrometer screw *MS* is provided with a worm-wheel *WW* which is operated by the worm *W* fastened to the bedplate *B*.

The accuracy of the compound interferometer depends mainly on two things:

1. The parallelism and flatness of the optical mirrors.
2. The parallelism and flatness of the ways on which the three carriages, *C*, *C'*, *C''*, move along.

To make the mirrors necessary for this instrument is an art by itself. Mr. O. L. Petitdidier of Chicago made them for Prof. Chamberlain's instrument, and did it with such precision that the mirrors used were at no place more than 1/1,000,000 of an inch out of true.

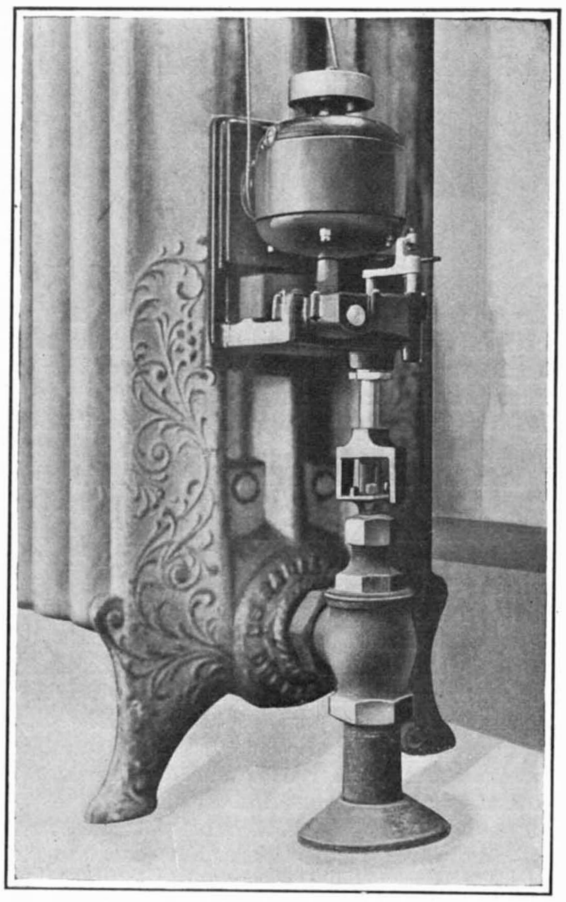
The ways the carriages travel on have to be flat, as well as parallel, to a very high degree of accuracy; the ways on the first instrument built were so accurate that, if they had been enlarged to a length of two miles, the parallelism would at the end of the two miles have varied not more than $\frac{1}{16}$ of an inch.

The optical system of the instrument shown in the diagram, Fig. 4, consists of four glasses. *M* and *M'* are the two end glasses fastened in the mirror holders *mh*. The surface of these two glasses toward the middle glass 2*M* is covered with a very thin film of silver, making of them total reflecting mirrors. These two glasses have to be flat to the very highest possible degree of accuracy. The middle glass 2*M* consists of two glasses of exactly the same dimensions cemented together with canada-balsam. About two thirds of the length of 2*M*, 1 to 2 and 1' to 2', on the sides toward *M* and *M'*, is another fine silver film to act as a total reflecting mirror and between the two glasses from *a* to *a'* is placed a silver firm of such a thickness as to split a ray of light that strikes its surface in two, letting one half of the light through and reflecting the other half; this part of the mirror is called the dividing plate. These two glasses have to be flat as well as parallel to the very highest possible degree of accuracy.

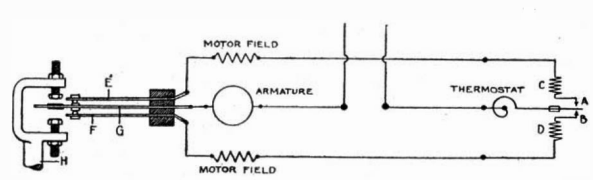
To adjust the instrument we proceed as follows: First we level our instrument by means of the leveling screws *ls;* after this we adjust the two end mirrors *M* and *M'* perpendicular to the fixed mirror 2*M* by means of the micrometer-adjusting screws *as;* then we make the distance between 2*M* and *M* and 2*M* and *M'* as nearly alike as possible, using the worm *W* and worm-wheel *WW* for that purpose. Now we set *M* at a small angle to 2*M* and *M'* at nearly the same angle, using for this movement worm and worm-wheel *w*, *ww*, respectively. The source of light, say a sodium flame, is placed at *S* (see Fig. 4). A ray of light from the source *S* enters the instrument, striking the dividing plate *a*, *a'* and being split in two equal fractions, one half of the ray passes through the dividing plate and is reflected a certain number of times between the total reflecting mirrors 2*M* and *M'* until it comes to a place where it strikes *M'* perpendicular; then the ray of light travels back over exactly the same path to *a*, *a'*. The same thing, of course, happens to the other half of the ray, which is reflected from *a*, *a'* and thrown toward *M*. At *a*, *a'* the returning parts are split once more, one half going back to the source of light, the other one leaving the instrument in the direction toward *T*. At *T* a telescope is placed, through which we observe the occurrence in the instrument, and what we see is a set of yellow and black fringes—interference fringes. If the instrument happens to be adjusted to its lowest power, then the distance between two fringes represents one half wave-length of light; that is, the same sensitiveness the most perfect compound microscope possesses; but by changing the angle of *M* and *M'* in relation to 2*M*, that is making this angle very small and thus forcing the light to pass oftener between 2*M* and *M* and 2*M* and *M'* before it strikes *M* or *M'* perpendicularly and returns over the same path (in other words, by increasing the length of the path of light by changing the angle between 2*M* and *M* and 2*M* and *M'*) we are able to increase the sensitiveness of the instrument forty times higher than the Michelson-Morley interferometer or four hundred times higher than the most perfect compound microscope.

One of the photographs shows an arrangement to illustrate the enormous sensitiveness of the instrument; the massive steel plate with its 2-inch post on one side is forged out of one solid block of steel and weighs about 150 pounds. This 2-inch steel post is capable of transmitting 200 horse-power. We are all familiar with the rigidity of steel, yet this instrument readily shows the bending of this heavy steel post when touched with the finger as lightly as possible. We can see what is an apparently great movement of this rigid steel post when it is delicately touched with a camel's hair brush, as shown in the picture. One will even observe a distinct movement when the breath is slightly blown against it, and when a match is dropped on this 150-pound steel plate it causes the steel post to flutter like a feather in a stiff breeze, and yet this instrument was adjusted to only one tenth of its real sensibility when these demonstrations were made.

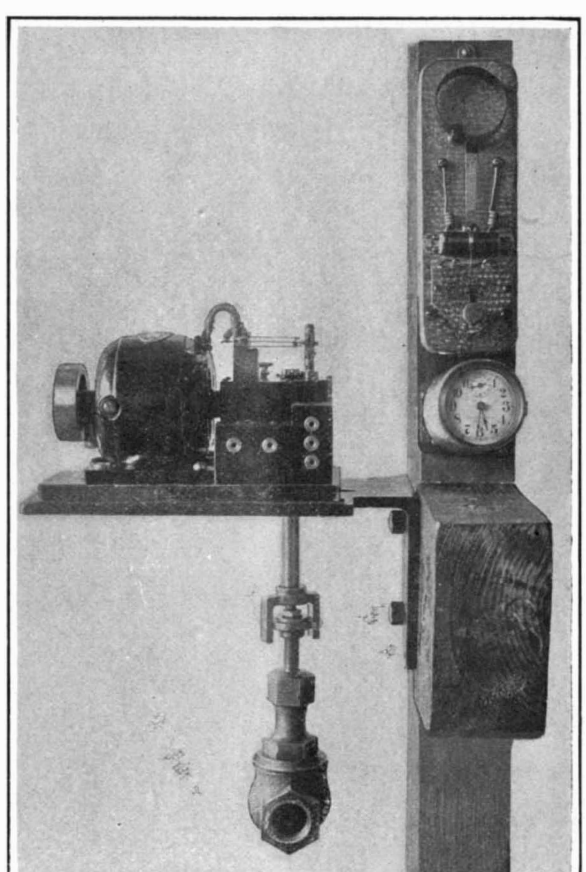
No fewer than five different forms of compound interferometers have been designed by Prof. Chamberlain and all of these instruments were constructed in the instrument shop of the Barney Physical Laboratory at Denison University, Granville, Ohio. One of these instruments was taken abroad and demonstrated before a committee of distinguished scientists by the writer; it created there an astonishing sensation, as it did wherever it was shown. By request of the Ohio Commission a complete set of these instruments was exhibited at the Jamestown Exhibition and received the highest medal awarded to an exhibition of scientific instruments. At a meeting of the American Physical Society held in New York city, Prof. Chamberlain presented his compound interferometer with full demonstrations, thereby placing the benefits of his labor at the service of all scientific investigators.



**Automatic electric apparatus for operating a radiator valve.**




**Electrical connections of the radiator controller.**



**Electro-thermostatic control as arranged for demonstration purposes.**

## Electro-thermostatic Control of Radiators

SOME time ago the SCIENTIFIC AMERICAN described an electrical starter for automobiles, using a very small motor. The motor itself was not powerful enough to turn over the engine directly, but by speeding it up sufficient energy was stored up in a flywheel to accomplish the task. Again last year the SCIENTIFIC AMERICAN described an electric brake in which the same principle was employed. Now a third application of this principle of stored energy has been brought out in connection with a thermostatic control of radiators.

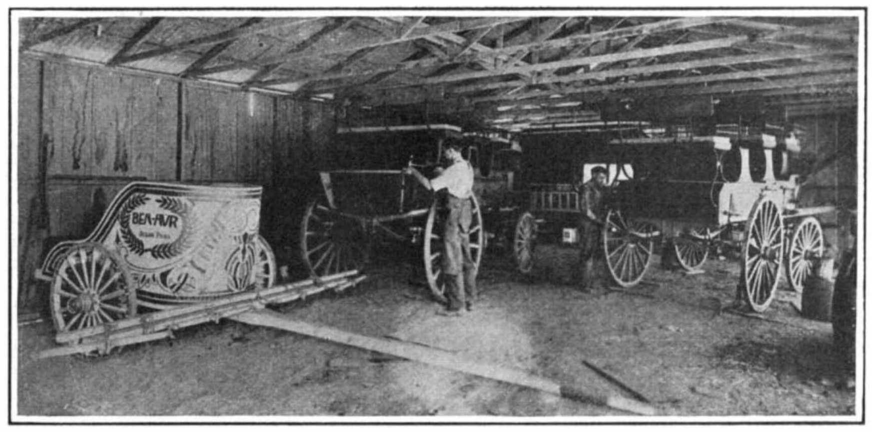
There are systems now in use for operating the valves of a radiator by means of compressed air under control of thermostats. The majority of them, however, labor under the disadvantage that they involve the installation of an elaborate system of air-compressing machinery and compressed air piping which cannot be installed without considerable expense, except during the construction of a building. The idea of controlling the valve by electricity, which would simplify the installation, has not met with much favor hitherto, because it has always been supposed that a very large motor would be required to open a valve that was tightly jammed or to close it steam tight. But by the use of energy stored in a rapidly rotating flywheel, the valve may be operated with a very small motor, as has been proved by Mr. E. V. Hartford, inventor of the apparatus shown in the accompanying illustrations.

One of the photographs shows a demonstration device partly dismantled so as to disclose the details. The clock shown in the photograph is used to switch on an electric light, every so often, the heat of which actuates the thermostat and thereby causes the valve to be closed and opened. The motor used is of only 1/100 horse-power and is operated by the common 110-volt lighting circuit. This current is switched on and off directly by the thermostat without a relay, and to prevent excessive sparking a trip is used to make an absolute and effective contact at each throw of the switch. As will be observed in the illustrations, at each side of the thermostat arm there is an electromagnet, while a small disk of soft iron on the arm serves as an armature. Thus, when the arm is deflected to one side or the other, by variations in temperature, it plays between two contact points *A* and *B*. But the instant it touches one of these contact points (say *A*), the electromagnet on that side (*C*) is energized, attracting the arm and making a solid contact, admitting current to the motor. As shown in the diagram, the field of the motor is split, one half being connected with *A* and the other half with *B*, so that its direction of rotation may be reversed by changing from one contact point to the other. As soon as current is supplied to the motor, it runs up to a very high speed, and by means of a step-down gearing in the ratio of 360 to 1, it turns the radiator valve, either opening it if fed through contact *B*, or closing it if fed through contact *A*.

In order that the motor may run up to full speed, it must start with no load. Consequently it is not directly coupled to the stem of the valve. Instead, its operating shaft terminates in a fork adapted to come into contact

(Concluded on page 369.)

A scene in Tangiers staged in California.



The vehicle repair shop.

# The Strangest City in the World

## A Town Given Over to the Moving Picture

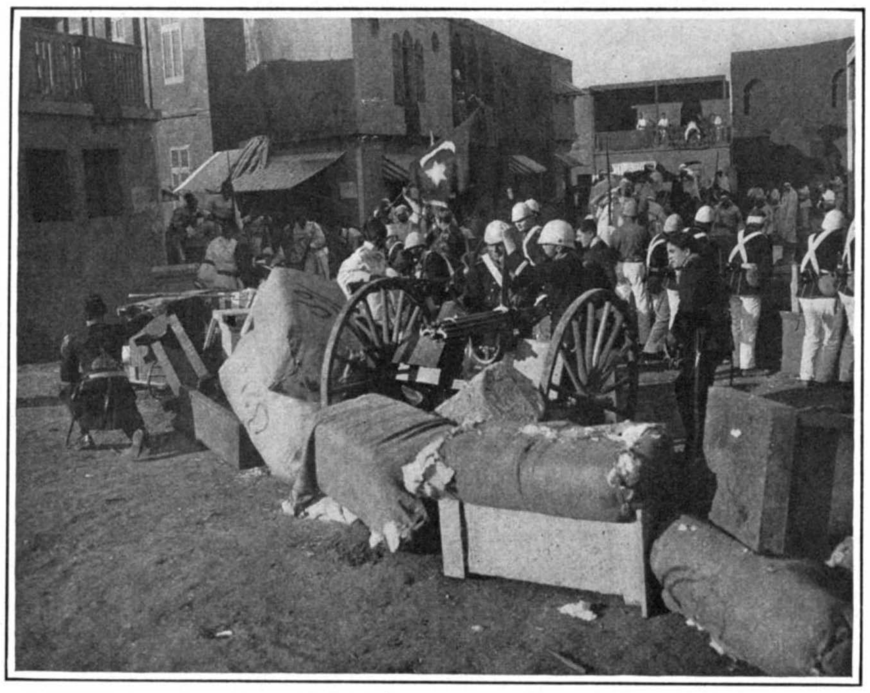
THERE is a wonderful city out in the heart of the San Fernando Valley, in the State of California, which is probably the most unique city in the world. Its name is Universal City, and it is the only municipality in the universe devoted to the manufacture of moving-picture films. It was officially opened on March 15th, and its population of 1,500 people are all employed in the art of making pictures. It is the make-believe city of the twentieth century, and one never knows, as he strolls about the streets of this city, whether what he sees is real or just "reel" views.

A stroll through Universal City is like going through the pages of a wonder book; a fairy tale for children. It is nothing more or less than a chameleon city, for the entire complexion and appearance of Universal City can be changed in three days to conform to any nationality, style of architecture, color scheme, or state of preservation which occasion requires. Troy, Athens, Rome, Paris, London, and New York are all distinguished and characteristic cities, but Universal City combines everything which can be found in any of these cities, and could represent all of them inside of a week, that is, for motion-picture purposes, for there is not a building in the entire limits of the city which could not be changed over night into something radically different and changed back again with equal facility.

There is no utility shop put up for the use of workmen even which could not be turned into a barracks for the quartering of soldiers, a hovel for the entertainment of thieves and desperadoes, or a ranch house for use in some western drama. The administration building itself is built with a different face on every quarter, and one of the shocks to which unsuspecting visitors at the city are likely to be subjected is the return through it from a different direction, and the realization that from that quarter every building presents a different aspect from that first seen. It is this ability to change its color at the slightest wish which makes this city the most remarkable which has ever been constructed.

As to when Universal City will be finished it is a very difficult matter to say. It has already been two years under construction, but there is no end to the possible improvements. It already has its own mayor, police, fire, street cleaning and educational departments, and, in fact, everything which can be found in the average modern city. All of the streets had to be scientifically paved and piped for gas, electricity and sewer mains. The main boulevard of the city is six miles long, and this will give an idea of the amount of work the Street Department alone has to do. The roadways of the city are peculiar in that they are of different widths and styles of top dressing, so that there will be as great a variety in this respect to choose from for scenic purposes.

The Zoo is housed in especially constructed buildings and cages, and is now the largest and finest privately owned menagerie in the world. There are African lions, leopards, tigers, wolves from the Siberian steppes, jackals, wild dogs, mountain lions, reptiles of all descriptions, from the mighty python to the hooded cobra, alligators, crocodiles, camels, dromedaries, a herd of elephants, nine different kinds of plumage birds and many others, like the American eagle and the vulture, a complete dog kennel of prize-winning thoroughbreds, all kinds of domestic animals, and a large herd of wide-horned cattle, bison, buffalo and cowponies, wild horses and gophers. These buildings have been completed and the animals have taken part in many big jungle pictures which have been seen by the public. The administration building, which houses the reception hall, meeting room, bookkeeping department, cashier's department, a suite of eight rooms for the scenario department, the library, stenographer, telephone exchange, telegraph office, auditor's and general manager's office, cost $30,000. Its façades are all different, representing different interiors and different styles of architecture. The laboratory has the same peculiarity of exterior appearance. There is also an exhibition theater, which takes on either the appearance of a city or a country theater at the behest of the director. There are barracks for housing the troops of expert cavalrymen and bunk houses for the cowboys. All of these are modern and sanitary, and can be used for many other things from the moving-picture standpoint.



An oriental street scene staged at the "Movie" city.

One of the most picturesque spots in the city is the Indian village, which is the largest in America, and is inhabited by a tribe of redmen who are permitted to pursue their lives as they please, for they are not encouraged to adopt modern customs or costumes.

There are two restaurants as capacious and as well served as any in the city of Los Angeles, which is eight miles north of Universal City. These are for the convenience of actors who have no habitation in the city itself. The wonderful revolving stage is one of the most up-to-date features of this city, and includes many innovations and a rocking stage made especially for children's productions.

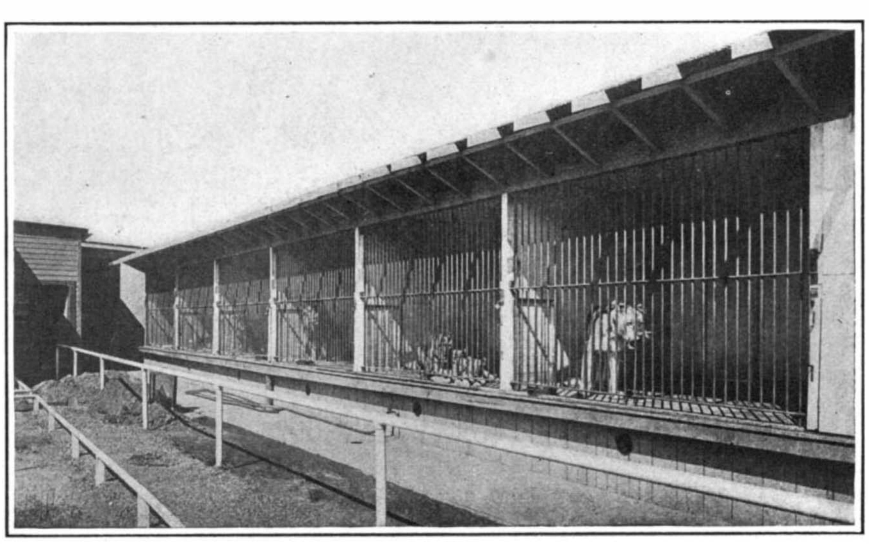
The wardrobe department contains costumes of every conceivable sort, and in addition to this are the costume shops, which can turn out the designs which are required by every period of dress, from the era of palm leaf girdles to the present time.

The five hundred dressing rooms are fireproof and are equipped with hot and cold running water, electric and gas lights, and steam heat. There are also bath rooms and swimming pools for both men and women.

There are two hospitals and infirmaries thoroughly equipped with every modern instrument for surgical and pathological remedy, and these are under the direction of two physicians, assisted by a corps of trained nurses.

Several corrals contain, among other animals, sixteen English thoroughbred saddle horses, four white Arabian steeds and one hundred and thirty-six head of Western horses, four long-horned steers, twelve burros and twelve military mules, and twelve Shetland ponies. The carriage house is equipped with some forty vehicles, ranging from the chariot of Homer's time to an up-to-date phaeton or landau; while the garage next door contains thirty cars of every description and the machinery for equipping and repairing. The blacksmithy and harness shops are all under the supervision of experts and are thoroughly equipped for the purpose intended.

For the outdoor enjoyment of the Universalites, there is a quarter-mile race track, with concrete grandstand and stadium in the most approved university style. In this arena can be staged any kind of play calling for outdoor sports, and it is open at all times to the athletically inclined who wish to keep in trim for their arduous duties in the films. Like all other buildings in the city, this arena can be changed on short notice to represent a number of different settings. One day it may be necessary to use it for the Coliseum at Rome and another for a country fair. It can be used for an Indian durbar or a golf link.



Animal cages at Universal City.

### Horse-power of a Rainfall

FEW people realize the energy in a fall of rain. On the evening of October 9th, 1914, there fell at Kansas City, Mo., in two hours 1.79 inches of rain. Assuming that this rain covered an area 4 miles square, or 16 square miles, and that it fell from an altitude of 6,000 feet, the energy represented was about 6,300,000 horse-power-hours. Were this converted into electrical energy without the usual losses it would amount to nearly 4,700,000 kilowatt-hours. At 10 cents per kilowatt-hour, this energy would cost $470,000.

## A Machine that Takes Off Fat

A MACHINE that will do one's exercising for him without exertion on his part has been tried out at a Chicago hospital. Its primary purpose is to reduce weight, without requiring exercise or dieting, and repeated experiments have demonstrated its success.

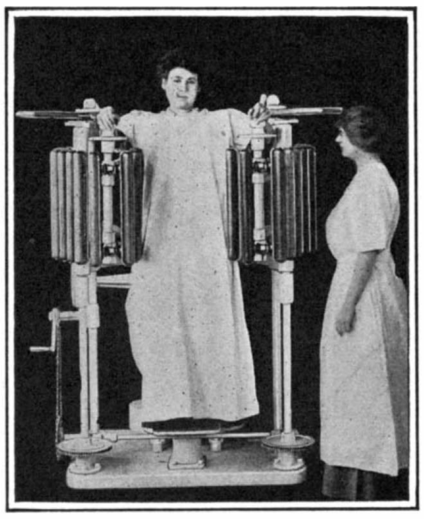
About all the patient has to do is to remove his—or rather her, since most of the patients are women—outer garments and put on something closely resembling the old-fashion mother hubbard. Then she is strapped into the apparatus. An operator touches a switch, an electric motor starts buzzing and the machine does the rest.

The machine has a platform which can be raised or lowered to any altitude desired. About half way up it has two large belts of wooden rollers, each roller being two feet long and about two inches from its neighbor. The patient stands on the platform which is raised or lowered so that the rollers will inclose him about the hips, stomach or shoulders as desired. An ingenious crankshaft arrangement makes it possible for the rollers to be adjusted closely around the circumference of the body.

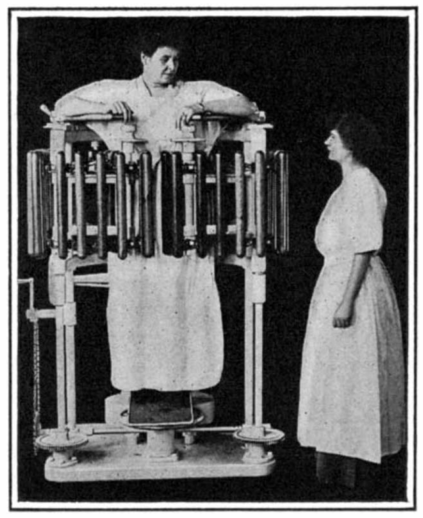
When the machine is adjusted about the patient he is held immovably in it. His arms rest upon small platforms provided for that purpose. The motor causes the belt of rollers on each side to turn, so that they will massage the body within a regular motion. The amount of pressure or speed can be adjusted according to the needs of each particular case.

It is claimed that the rollers massage the body in such a manner as to break up fat particles. At the same time the blood circulation is increased to an abnormal degree. The fat particles are dissipated, carried off by the blood and later eliminated by natural processes. Enough pressure can be obtained to give the body a rosy glow all over, clear to the finger nails, without, however, inducing perspiration or having an deleterious effect. In other words, all the physical effects of vigorous exercise can be obtained without requiring direct exertion.

The athletic department of Chicago University was the first to try it out. It was used there for the cure of "charley horse," a condition arising from bruised muscles among athletes, and its curative powers were so great that the coaches enthusiastically indorsed it. Coach Stagg of Chicago is quoted as saying his men have had no permanent "charley horses" since the machine was installed.



Patient entering the machine.



Adjusting the rollers to the body.

**A machine that takes off fat.**

## Were the "Eoliths" Made by Man?

IN the course of his lecture, at a recent meeting of the Royal Anthropological Society, Mr. Charles Dawson, fellow of the Geological and Antiquaries Society of London exhibited many paleolithic flint implements of the early Pleistocene period, including a large fossil elephant bone sharpened to a point like a stake. This was found near the Piltdown skull.

There were also found in the gravel numerous "Eoliths"; that is, what some anthropologists think were the earliest form of implements used by man. (*Eo* = dawn — *Lithos* = a stone = *Dawn Stones* or implements.) These were supposed by some to carry the advent of the human race far back into the mists of geological ages; as to which proposition there has been much dispute.

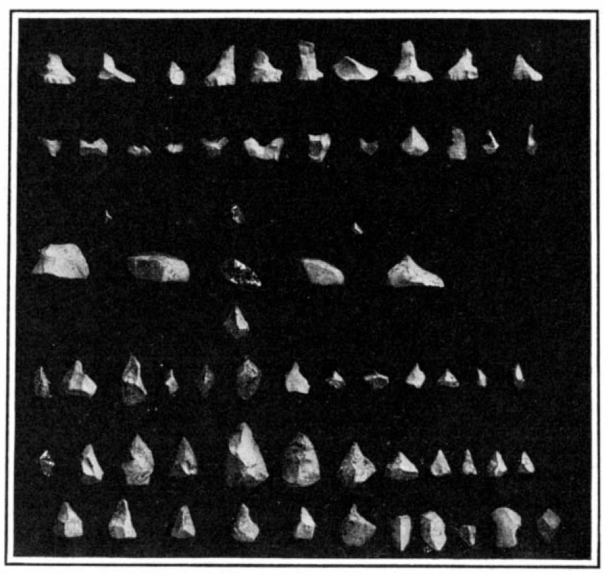
Mr. Dawson and Dr. Smith Woodward would only admit the Piltdown skull to a modest early Pleistocene period (say 200,000 years), while Keith, Harrison, Sir Ray Lankester, Reid-Moir wanted to place man thousands, if not millions, of years earlier in the Pliocene period.

C. Dawson would not admit the "eoliths" as the work of man at all. He said these "eoliths" are merely fragments of prismatic flint a little edge-chipped by rolling in the gravel, and this had caused their present form and peculiar fractures, making them to resemble "hollow-scrapers" "borers," "planes," "rostro-carinates," and so forth.

He pointed out the resemblance of prismatic flint to starch and starch-fractures which are also prismatic, and said he had made the surprising discovery that one bag of starch contained a whole series of these eolithic implement-like forms, in miniature. It was a game anyone could play, provided he knows what an eolith is like and possesses a bag of starch.

Indeed it was only necessary after having hunted out one series, to sit on the bag to obtain a whole fresh series of "eoliths."

Starch prisms.



Starch "eoliths."

**Evidence that implements of the stone age may be natural formations.**

## Stretcher for Trench Use

THE great European conflict has become a war of the pick and shovel, so far as operations in the western sphere are concerned; for here we find that both armies have dug themselves in and are fighting from trenches and by means of mines and countermines. This extensive trench fighting has called for a special type of stretcher which will permit of carrying the wounded through the zigzag trenches back to the field hospital. The ordinary stretcher takes too much room. As the wounded man must be carried in an outstretched position, it is difficult to convey him through the many twists and turns of the trench line. If only the wounded man could be carried in an upright position or in nearly upright position, it would be a simple matter to convey him to the rear. To permit of this the type of strecher shown in the accompanying photograph has been devised. It is really a compromise between a stretcher and a chair, being similar in shape to a steamer chair. With this type of stretcher the wounded man is carried in a reclining position which is almost a sitting posture. The stretcher has been adopted by the French army.

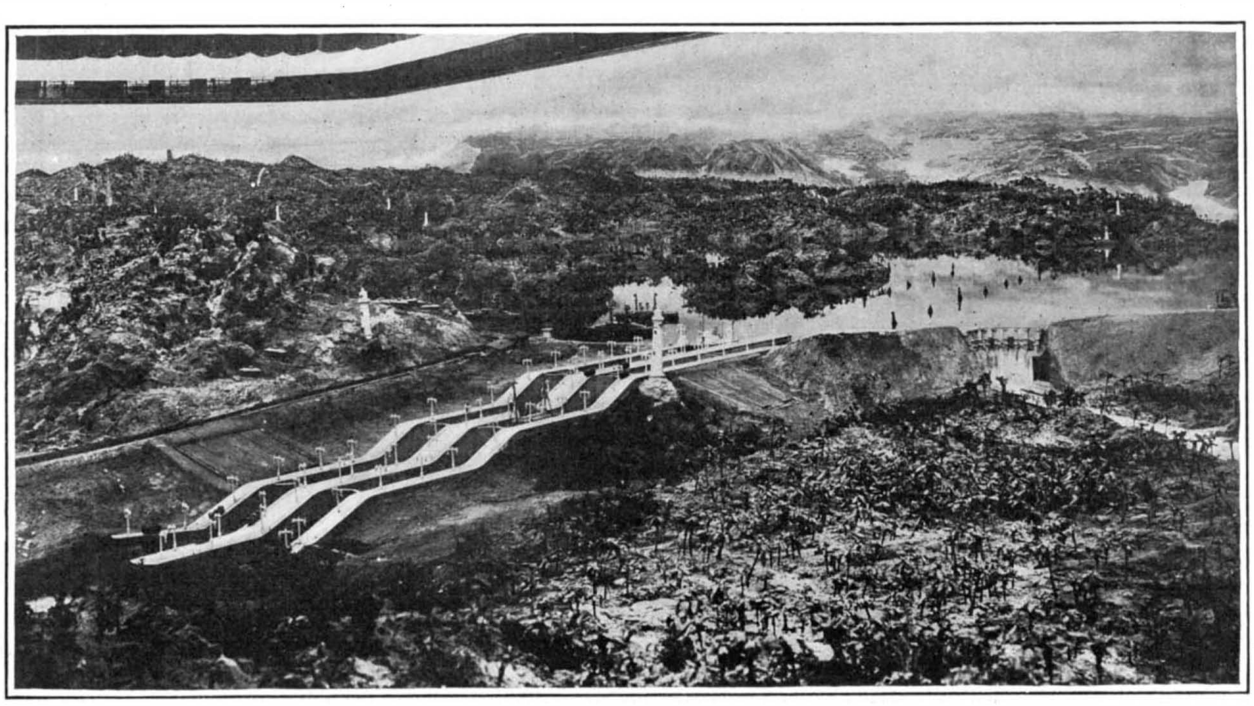
Copyright by Branger.

**Special form of stretcher used in trenches.**

## A Five-acre Model of the Panama Canal

THE fact that the Panama-Pacific International Exposition at San Francisco is commemorative of America's gigantic achievement, makes the reproduction of the famous waterway between the Atlantic and Pacific, as it is found on "The Zone" at the Exposition, one of the most interesting concessions along that big amusement thoroughfare.

Passing up a broad runway the visitor arrives before the longest moving platform in the world, on which seats for thousands are placed. The entrance to this platform is at the Pacific entrance to the canal, and as the spectator takes his seat a pair of disks are placed at the ears and as the journey is begun a phonographic-telephonic apparatus begins a clear and impressive lecture of the great concession, which now lies spread before the eye in the minutest detail. Each point of interest throughout the entire canal zone as reproduced at the exposition, is numbered and the phonographic lecture prefaces each description with the number at that time directly in front of the spectator. This arrangement in itself is one of the great achievements which combine to make the



**Enormous model of the Panama Canal exhibited at the Panama-Pacific Exposition.**

canal concession a wonderfully interesting one, and the fact that the platform journey consumes over half an hour shows on what a stupendous scale the whole exhibit has been arranged.

The moving platform, operated by electricity, is nearly a mile in length or would be were it placed in a straight line instead of traveling a circular course. As the Pacific entrance is passed, tiny boats operated by magnets placed under the surface of the water, enter and leave the locks, while speeding trains, brilliantly illuminated, can be seen rushing over the rails of the Panama Railroad. At night the canal is illumined with the red and white buoys which mark the channel. Big wireless towers discharge their messages into the air from various parts of the canal right of way and the scene is one of great interest and activity. The model was constructed at a cost of $300,000.

## Raising the "F-4"

(*Concluded from page 355.*)

ter is perhaps the more difficult matter. A gradual deterioration of the air one breathes is apt to escape attention for awhile. And yet it is the oxygen supply that enables the diver to perform his work. To distinguish between the effects of his own muscular exertions and those resulting from a devitalization of the air would seem to be something requiring cool judgment and experience.

Perhaps the most notable advance in connection with the development of deep diving is the utilization in training of artificial means of reproducing deep water conditions. It is by this method that Gunner Stillson's party has been brought to a high state of efficiency. It was such training that prepared Chief Gunner's Mate Drellishak for the accomplishment of his record-breaking feat.

One of the manufacturers of diving apparatus has installed at their works in Brooklyn a large pressure tank. This tank consists of a steel shell in the form of a vertical cylinder in which the contained water may be put under any pressure desired up to one corresponding to a depth of 250 feet or more. Drellishak and companions, one at a time, experienced in this tank pressures up to 110 pounds per square inch. The pressure is applied by means of an air cap covering the surface of the water. The tank is 7 feet in diameter and contains under normal conditions perhaps 8 feet of water. At four points in circuit there are glass windows 1 inch thick, which permit observations from the outside. The interior is lighted by electricity. It was found necessary, however, to filter the Brooklyn water in order to make the lighting effective. The diver puts on his diving suit as if he were going down in open water and descends into the tank. The cover is secured in place and compressed air turned on both for the tank and for the diver. In this way, precisely the same pressure conditions may be reproduced as would exist in a real case of diving. By increasing the pressures, the conditions at any desired depth within the pressure capacity of the apparatus may be reproduced. The advantage of the tank lies in the large fact that with it a diver may be closely watched when learning and any defects in his equipment or his mental reactions learned. Mistakes are not so dangerous with such a tank. This promotes confidence and makes possible the practical development of man and apparatus.

The type of equipment to be used by the American navy divers at Honolulu is, in the main, that used by the British navy. There is the helmet, the breastplate, the air-pipe, the telephone, and the life-line. At Honolulu, the air will probably be supplied by a power compressor located on an attendant vessel, and not by the hand-worked pump usually employed in diving operations. The diving procedures that are to take place in connection with the raising of the "F-4" differ from others not so much in the mechanical appliances as in the thorough-going preparation of the men for deep work. It has been found desirable to have a de-

compression chamber. This consists of a big tank, resembling a horizontal boiler, in which a diver who has come to the surface too rapidly may be placed and subjected to the air pressure deemed desirable for promoting his recovery. The pressure may be reduced as slowly or as rapidly as necessary.

### Development and Perfection of Schoop Metal Spray

(*Concluded from page 362.*)

mixture of cold working and rapid liquefaction and solidification.

The need of methods whereby one metal can be coated with another has always been felt. It has led in the past to the various processes of hand-plating and the absolutely necessary electro-plating. The latter has its limitations for universal application, one of these being the size of the baths, and another, the fact that the acids employed corrode and injure some of the metals that one would like to treat. Then there has been inability to deposit in such ways the commoner protective metals like lead and aluminium, the latter never having been amenable heretofore to coating processes. It may thus be seen that there is a wide field in larger industrial protective processes.

The electrical fusion of copper dust on non-conducting surfaces is a process employed for coatings of metal, but this is as a decoration and at a price that is practically prohibitive for a protection. There are also processes of dry galvanizing, Sherardizing, etc., but these are comparatively expensive, or lack flexibility, and some of them are merely temporary. The processes have thus been restricted in the choice of coatings and imply temperatures or chemicals or unaccommodating apparatus. On account of limitations of the kind there has been no better preservative for engineering works exposed to weather or other chemical action than painting or using enamel, with the results that are familiar to everyone.

The principle of the spray has already been described and illustrated in earlier accounts in the SCIENTIFIC AMERICAN. The first suggestion and the first trials along the line of the present success were with molten metal. A jet of air or gas moving with velocity lifted the liquid metal from a reservoir prescisely as the jet from a common atomizer lifts the disinfectant from the bottle. There were mechanical and economic difficulties involved in this. On the one hand there were the problems of attaining and maintaining the high temperature necessary to the molten metal, and on the other hand the necessity of melting perhaps a ton of metal when a few pounds only were to be used. The apparatus was cumbersome and the process was confined to metals and alloys of low melting point. One of the difficulties was the cooling effect of the spray—an expanding gas—and unevenness characterized the results. With tin and lead a moderate measure of success was attained.

Next Mr. Schoop tried the application of powders artificially produced. Such dust, acted upon by gaseous jets and with heat and pressure, has been impacted upon a base with some success. The form of apparatus termed "Cyclone" is in use, but it deals entirely with zinc. Other metallic powders prove to be rapidly oxidized.

The third step in this interesting evolution was the pistol, and evolution is an appropriate word, for from an original of a ton or more in weight it has been improved down to its present form, a compact, convenient hand instrument of 3½ pounds.

The pistol itself has been subject to improvement, its earliest form having its motor driven by the compressed air which afterward was used for the spraying jet. A second form located the motor in the top of the pistol, with its power through a by-pass and exhausting into the air, the jet being produced by its own supply of compressed air. This pistol is a cubical box of about 3½ inches to the side and is still in use. An improvement developed in this country, and now being set up, re-

**places the brass box with an aluminium cylinder. The grip is centrally below the cylinder, giving greater ease of control** and better balance, the most awkward factor, the tube for compressed air, entering conveniently through the grip. The tubes of the gases for combustion are attached to the muzzle, where they communicate directly with the mixing chamber.

The motor is now located in the bottom of the pistol with a long shaft running to a bearing in the lower end of the grip, insuring stability, smoothness of running, and opportunity for long-lasting lubrication. These features are desirable for the motor runs with a speed of about 25,000 turns a minute. It is the intention to place the motor while the pistol is in the factory, to which it may be returned for repairs. The feed mechanism for the wire is to be mounted on projections cast on the cover of the motor well, making a single group that can be withdrawn for inspection, and a cover closes the pistol on the top.

In the advance publication on the subject in the Institute of Metals, Morcom presents the following table:

DATA FOR SPRAYING VARIOUS METALS.

| Metal. | Diameter of wire used. Millimeters. | Rate of feed, Grammes, per second. | Gas used per minute in cu. ft. Hydrogen—Oxygen. | | Gas used per minute in cu. ft. Coal Gas—Oxygen. | |
|---|---|---|---|---|---|---|
| Aluminium | 1.0 | 9.5 | 1.5 | 0.5 | 0.7 | 0.6 |
| Brass | 0.8 | 17.0 | 1.5 | 0.5 | 0.8 | 0.65 |
| Bronze | 0.8 | 17.0 | 1.5 | 0.5 | 0.8 | 0.65 |
| Copper | 0.8 | 14.0 | 1.8 | 0.6 | * | * |
| Cupro-Nickel | 0.8 | 12.0 | 1.8 | 0.6 | * | * |
| Gold | 0.8 | 45.0 | 1.5 | 0.5 | * | * |
| Iron | 0.8 | 8.0 | 2.0 | 0.7 | * | * |
| Lead | 3.0 | 300.0 | 1.0 | 0.35 | 0.45 | 0.4 |
| Nickel | 0.8 | 9.0 | 2.0 | 0.7 | * | * |
| Silver | 0.8 | 18.0 | 1.5 | 0.5 | * | * |
| Tin | 2.0 | 200.0 | 0.8 | 0.3 | 0.35 | 0.3 |
| Zinc | 1.0 | 45.0 | 1.2 | 0.45 | 0.55 | 0.5 |

*Indicates that the experiments are not completed.

It has been proven by experiment that there is a definite efficiency point with each form of pistol, and with a given form there is nothing to be gained by increasing pressures. The general ratio is 1.5 feet of hydrogen to 0.5 foot of oxygen, or 0.8 foot of coal gas to 0.65 foot of oxygen. It is true, however, that for the refractory metals a little may be gained by forcing, but for the others the figures given are the maximum.

The costs of the process are not prohibitive even for the finer metals, while for lead it is figured to be between one and two cents a square foot, and one pound of the metal may be sprayed in a minute.

It is still too early to indicate, save in the most general way, the possible applications for a process that will coat with a metal film almost any desired surface, although, in fact, it is in daily use in manufacturing establishments in the country. Attention was called to it in France as a means of renewing lead linings in drums used in acid processes, while the Northern Railway Company experimented on its suitability for metal coating the bases of telegraph poles.

The obvious broad use of it is to preserve from decay in the atmosphere, or through moisture or chemical action, the surface of any coherent substance, including wood, paper, *papier maché*, stone, cement, and the like. Then it will preserve the vulnerable metals like iron steel in every variety of their uses. It is applicable to the treatment of any portion of an object and different sections of the same surface may receive coatings of different metals. It may be used for plating in its usual sense, where a dense continuous surface is required, and is applicable to other processes where porosity as well as permanence is desired. It is further available for fine replicas which may be made in detachable shells, and in electrical resistance and conduction lie other important fields of use.

## Electro-thermostatic Control of Radiators

*(Concluded from page 364.)*

**with a pair of lugs projecting from a disk**

on the end of the valve stem and shown clearly in the photographs. There is enough play in this coupling before the fork comes into contact with the lugs to permit the motor to run up to full speed, when it has built up enough energy to start a valve that would be difficult to turn by hand.

In order to cut the supply of current to the motor in time and yet provide an absolute seal of the valve, the controller shown at the left hand end of the diagram is used. Here it will be seen that there are three contact strips, *E* connecting one field motor, *F* with the other field motor, and *G* with the armature. Contact *G* has an extension that projects between a pair of adjusting screws on the controlling arm *H*. The arm *H* is geared to move up or down slowly as the valve is opened or closed. Normally, the spring contacts *E*, *G*, and *F* are in contact, but just before the valve is closed the arm *H* will have been moved down enough to depress the spring *G*, breaking the contact with the spring *E* and thus opening the circuit of the motor, but owing to the momentum of the latter the valve will continue to move down until firmly closed upon the valve seat. On the other hand, when the valve is being opened the lower adjusting screw of the controller *H* will lift the spring *G* out of contact with the spring *F*, cutting off the current just before the valve is fully opened, and depending upon its momentum to complete the operation. The point at which the current is cut off, either when opening or closing the valve, depends upon the positions of the adjusting screws and the gap between them.

The economy of this system should be very marked. The temperature in a room does not ordinarily vary so much as to require frequent operation of the motor, and then the amount of current it consumes is practically negligible.

### An Important Moving-picture Decision

A DECISION has just been handed down by Judge Mayer of the United States District Court for the Southern District of New York sustaining two patents of Nicholas Power, covering certain features of motion-picture projection apparatus.

The patents in suit are No. 826,112, dated July 17th, 1906, directed to the framing mechanism of a projection machine, and No. 959,601, dated May 31st, 1910, covering the fireproof magazine and the fire extinguishing valve to prevent the entrance of the flame of a burning film into the magazine.

In regard to the framing mechanism patent, Judge Mayer says in part:

"Others were striving for a result, but Power attained it, and to-day his machine concededly dominates the market and its sales are remarkable. . . .

"Business ability, finely constructed machine parts, and a good selling organization cannot accomplish such a result without a basically satisfactory product. We are not dealing with some pleasing article which, for the time being, catches the public, but with a delicate mechanism which, to succeed, must consistently make good with the exhibitor and the audience.

"I am fully convinced that the patent is meritorious and should be sustained."

Concerning the fire valve patent, the opinion of the Court includes the following:

"We all know that motion-picture exhibitions are attended daily by many thousands of people and we all appreciate the danger which would result not only from fire,, but more seriously, perhaps, from panic.

"Thus, any instrument of fire protection becomes important which shall instantaneously extinguish fire and be so constructed and adjusted as not to scratch nor impair the film. . . .

"What the art needed from an efficient and commercial standpoint was a fire protection device which would also protect the film. It must be remembered that the film travels at the rate of about sixteen pictures per second, that splices are not unusual, and that scratching either destroys or impairs the film to the extent of seriously deteriorating the picture which is thrown on the screen. . . .

"In my opinion, it required a faculty more than ordinarily to be expected from the man skilled in the art to produce the Power valve. . . . Indeed, the prior art in respect of this device which now looks so simple but which was unattained by others, is, to my mind, convincing proof that what Power accomplished in this regard was invention."

# REGAL

## Power *with* Economy

Unquestionably, if all Regal owners could give expression to their opinion of the dominant feature of Regal cars—the one outstanding fact would be their unlimited power.

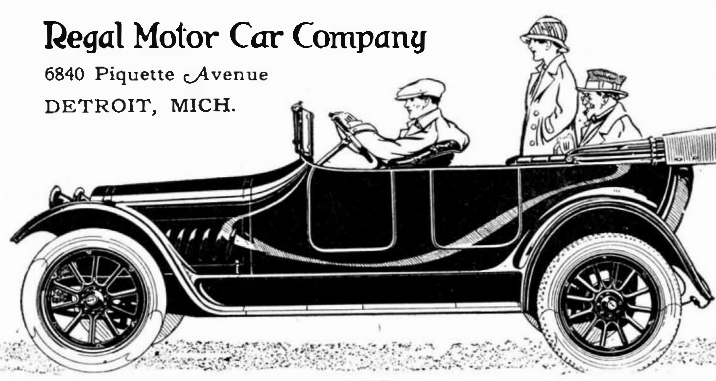
They are always hungry for the hills, and at a touch of the throttle leap forward as only an engine with surplus power and perfect balance can. Yet this power is secured with the greatest economy.

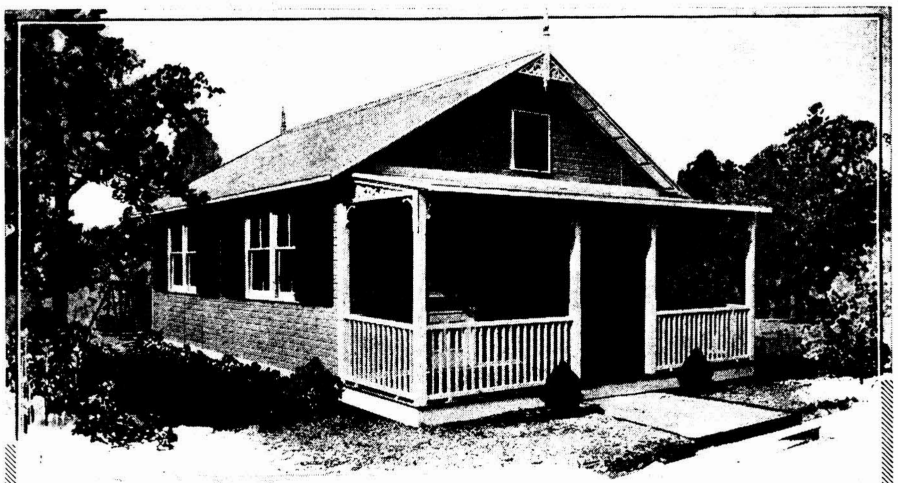
Now, there are Three Regals, all of the same rugged design and construction which has characterized Regals for eight years. Surely among them is one, suited to your needs—and your pocket book.

| | |
|---|---|
| A Light "Four" 106 inch wheel base | $ 650 |
| A Standard "Four" . . . . . . . . | 1085 |
| A "V" Type "Eight" . . . . . . . | 1250 |

All are completely equipped—electric lights, horn and starter—one man top, demountable rims included. All are comfortably roomy, have full streamline bodies, and crown fenders.

**Regal Motor Car Company**
6840 Piquette Avenue
DETROIT, MICH.





*This Bossert-Redibilt Bungalow, 18x24, 3 rooms $750.00*
*ABSOLUTELY COMPLETE. Immediate delivery*

## Bossert Houses are more than Portable

WHEN you buy a portable house you want a building that can be erected on any plot of ground with the greatest economy and speed—and that will give satisfaction either as a temporary or permanent home, no matter where it is placed, and regardless of climate or season. For these reasons you should not build or buy any house until you have fully investigated

## Bossert Redibilt Homes

**"NOT EVEN A NAIL TO BUY"**

Here are a few points of difference and superiority:

1—Bossert Redibilt Homes are *not* ready cut lumber but completely built houses. Merely a monkey wrench *is* required to put them together.

2—There are no nails or screws to drive—two ordinary workmen can put one up in from 1 to 4 days, according to size.

3—Erecting cost is reduced by the Bossert method of construction to 5 or 6 per cent of the cost of the house. When buying be sure to compare this cost with others.

4—Each section has air chambers and each air chamber is lined with felt paper—the roof is lined with asbestos, making the house cool in summer and warm in winter. No other portable house contains these valuable features.

5—No extra charge is made for painting—select any two colors desired, one for body and one for trimmings—two coats are applied at factory. Inside finished in oil.

6—All doors and windows are fitted and hung before shipping—any good carpenter will tell you what this means.

7—The best of hardware furnished throughout.

8—Window blinds, fitted and hung, come with all houses.

9—The lumber used in Bossert-Built Homes is particularly heavy and of superior quality, and is specially selected for its suitability to each part.

10—We have been building bungalows for over 25 years—this is the first time they have been trademarked and advertised.

11—Our prices are for complete homes ready to live in and range from $300. up, f. o. b. Brooklyn.

12—You can also buy Bossert Redibilt Garages, Boathouses, etc.

***Write for our New Catalog—it contains illustrations showing many attractive designs and quotes prices***

**LOUIS BOSSERT & SONS, 1305 Grand Street, Brooklyn, N.Y.**

# VALUABLE BOOKS of *Instruction* and *Reference*

### *Scientific American Cyclopedia of Formulas*

Edited by ALBERT A. HOPKINS. 6½x8¾. 1077 pages, 200 illustrations. Cloth, $5.00. Half morocco, $6.50.

¶ The most complete book of receipts published, containing about 15,000 selected formulas, covering nearly every branch of the useful arts and industries. Never before has such a large collection of formulas, useful to everyone, been offered to the public. Almost every inquiry that can be thought of relating to formulas used in the various manufacturing industries will be found answered in this volume. Those in search of salable articles that can be manufactured profitably on a small scale, will find hundreds of excellent suggestions.

### *Concrete Pottery and Garden Furniture*

By RALPH C. DAVISON. 5¼x7½. Cloth. 196 pages, 140 illustrations. Price, $1.50.

¶ This book describes in detail, in the most practical manner, the various methods of casting concrete for ornamental and useful purposes. It tells how to make all kinds of concrete vases, ornamental flower pots, concrete pedestals, concrete benches, concrete fences and many other objects of cement for the adornment of the home or garden. A valuable chapter on color work is included.

### *Scientific American Reference Book*

Edition of 1914. Compiled and edited by ALBERT A. HOPKINS and A. RUSSELL BOND. 5¾x7¾. Cloth. 597 pages, 1000 illustrations. Price, $1.50.

¶ A handy, compact, reliable and up-to-date volume for every-day reference, containing a remarkable aggregation of facts, statistics and readable information along industrial, commercial, scientific and mechanical lines of general interest. It is a revelation of facts and figures, and will prove invaluable on the desk of the business man, as well as the library of the home.

### *Experimental Science*

Elementary Practical and Experimental Physics. By GEORGE M. HOPKINS. 2 volumes. 6¼x9¼. Cloth. 1100 pages, 900 illustrations. Price, $5.00.

¶ This work treats on the various topics of physics in a popular and practical way and contains a fund of trustworthy scientific information presented in a clear and simple style. The aim of the writer has been to render physical experimentation so simple and attractive as to induce both old and young to engage in it for pleasure and profit. In the latest edition the scope of the work has been broadened, presenting the more recent developments in modern science.

### *Handy Man's Workshop and Laboratory*

Compiled and edited by A. RUSSELL BOND. 6x8¼. Cloth. 467 pages, 370 illustrations. Price, $2.00.

¶ A compilation of hundreds of valuable suggestions and ingenious ideas for the mechanic and those mechanically inclined. The suggestions are practical and the solutions to which they refer are of frequent occurrence. It may be regarded as the best collection of ideas of resourceful men published, and appeals to all those who find use for tools either in the home or workshop.

### *Monoplanes and Biplanes*

Their Design, Construction and Operation. By GROVER CLEVELAND LOENING, B.Sc., A.M., C.E. 6¼x8¼. Cloth. 331 pages, 278 illustrations. Price, $2.50.

¶ This work covers the whole subject of the aeroplane, its design and the theory on which the design is based, and contains a detailed description and discussion of thirty-eight of the more highly successful types. It is a thoroughly practical work, and invaluable to anyone interested in aviation.

*WE SEND THESE BOOKS BY MAIL OR EXPRESS PREPAID UPON RECEIPT OF THE ADVERTISED PRICES. OUR CATALOGUE OF SCIENTIFIC AND TECHNICAL BOOKS SENT FREE ON REQUEST. SEND US YOUR ORDER OR REQUEST TODAY*

**MUNN & CO., Inc., *Publishers*  233 Broadway, New York, N. Y.**

# Instructive Electrical Books

*A selected list of books treating on electrical subjects, including electric wiring, induction coils, telephony, wireless telegraphy, etc.*

### *Design and Construction of Induction Coils*

By A. FREDERICK COLLINS. 6½x9¼. Cloth. 272 pages, 159 illustrations. Price, $3.00.

¶ This work gives in minute details full practical directions for making eight different sizes of coils, varying from a small one giving one-half inch sparks to a large one giving twelve-inch sparks. The dimensions of each and every part are given, and the directions are written in language easily comprehended.

### *Complete Electrical Library*

By T. O'CONOR SLOANE, A.M., E.M., Ph.D. 5 volumes, 5¼x7¼. Cloth. Price, $5.00.

¶ An inexpensive library of practical and instructive books on electricity for the student, amateur, electrical engineer, the workshop, schools and colleges. The titles and prices of the volumes, when sold separately are as follows:

**Arithmetic of Electricity**
162 pages. $1.00.

**Electricity Simplified**
174 pages, 32 illustrations. $1.00.

**Electric Toy Making for Amateurs**
210 pages, 77 illustrations. $1.00.

**How to Become a Successful Electrician**
205 pages, illustrated. $1.00.

**Standard Electrical Dictionary**
682 pages, 393 illustrations. $3.00.

*Special Offer*—We will send, by mail or express prepaid to any address in the world, the above five volumes, handsomely bound in blue cloth with silver lettering, and enclosed in a neat folding box, at the special reduced price of $5.00 for the set.

### *Telephone Construction, Installation, Wiring, Operation and Maintenance*

By W. H. RADCLIFFE, E.E., and H. C. CUSHING, JR., E.E. 4½x6¾. Cloth. 223 pages, 132 illustrations. Price, $1.00.

¶ Describes up-to-date methods of telephone practice, including the principles of construction and operation of telephone instruments; approved methods of installing and wiring them; the means of protecting them from lighting and abnormal currents; their connection together for operation as series or bridging stations; and rules for their inspection, repair and maintenance.

### *Wireless Telegraphy and Telephony Simply Explained*

By ALFRED P. MORGAN. 5¼x7½. Cloth. 154 pages, 156 illustrations. Price, $1.00.

¶ A popular, practical and simply worded treatise, embracing complete and detailed explanations of the theory and practice of modern radio apparatus and its present-day applications. It is written so that it can readily be understood by men who are not technical, and at the same time is sufficiently comprehensive and practical to be studied advantageously by the ambitious young engineer or experimenter.

### *Practical Electricity*

By T. O'CONOR SLOANE, A.M., E.M., Ph.D. 4¾x6¼. Flexible cloth. 761 pages, 556 illustrations. Price, $2.50.

¶ This manual, formerly known as Sloane's "Electricians' Handy Book," is a self-educating work on electricity and covers the entire field of practical electrical engineering. It is popularly written and may properly be termed an Elementary Text Book of Electricity. It presents the essentials of the science, with a sparing use of the simplest mathematics, and tells the practical working electrician just what he wants to know. It is a practical book for the practical man.

### *House Wiring*

By THOMAS W. POPPE. 4¼x6½. Flexible cloth. 103 pages, 74 illustrations. Price, 50 cents.

¶ Describes and illustrates the actual installation of electric light wiring, the manner in which the work should be done and the best up-to-date methods of doing it. It gives just the information essential to the successful wiring of a building, without being too technical or overladen with details and contains nothing that conflicts with the rulings of the National Board of Fire Underwriters.

### *Electric Wiring, Diagrams and Switchboards*

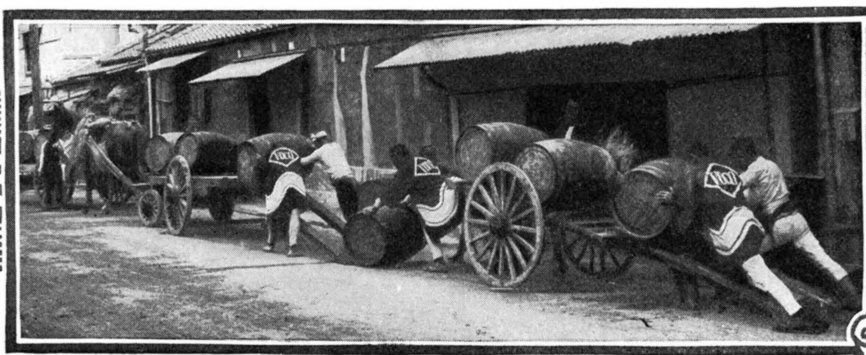
By NEWTON HARRISON, E.E. 5¼x7½. Cloth. 272 pages, 105 illustrations. Price, $1.50.

¶ A practical work of ready reference for the wireman, foreman, contractor, electrician and all others interested in the application of electricity to illumination and power. It covers the subject of electric wiring in all its branches. Direct and alternating current wiring are both fully treated.

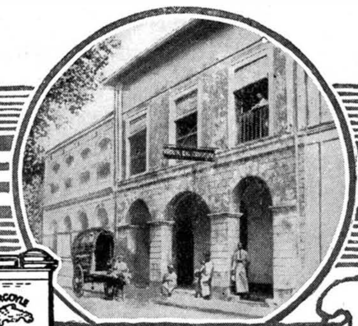
***We forward these books prepaid to any address upon receipt of the prices given. Our catalogue of scientific and technical books sent free on request. Write for one.***

**MUNN & CO., Inc., *Publishers*  233 Broadway, New York, N. Y.**

GARGOYLE LUBRICANTS IN SHANGHAI



SOME OF OUR JAPANESE EMPLOYEES



VACUUM OIL COMPANY, CEYLON

EN ROUTE TO BASUTOLAND AFRICA

# WON

## *How scientific experience is sweeping aside lubricating guess-work*

### To Automobile Owners:

FORTY-NINE years ago, the Vacuum Oil Company began business. From the beginning it specialized in high-grade lubrication.

Its lubricants quickly secured the highest recognition throughout the world in scientific circles and among power-engineers. Where operators dealt in horse-power by hundreds and thousands, the economy of the Vacuum Oil Company's lubricants was quickly proved. The value of the Vacuum Oil Company's advice on lubrication was readily measured in dollars and cents.

#### *The High Cost of Poor Lubrication*

Many years later came the automobile, the motor boat, the motorcycle and the aeroplane.

Add guesswork to carelessness and you have a general idea of automobile maintenance in those early days.

One dealer favored heavy oils; another light oils. Many said "all oils are alike." Some manufacturers claimed to have oil containing no carbon—shutting their eyes to the fact that such an oil could neither exist nor lubricate.

Many a motor car went to the scrap heap through ignorance of lubricating oils and lubrication.

#### *The Pocket-Book Appeal of Gargoyle Mobiloils*

But conditions changed. The automobile—one day almost wholly a sporting hobby—the next became a great utility.

Car manufacturers in their Instruction Books began to speak of correct lubrication as the most important single factor in efficient motor car maintenance.

Motorists ceased to buy cars on whim or to operate them in carelessness.

"Oils with no carbon"—"All oils are alike"— and other unsound theories began to lose ground.

*Mileage* per gallon was watched—rather than *price* per gallon. Power and economy of maintenance became more commanding than extravagance of claims.

#### *The Friendly Rivalry for Economy*

Today the skilful automobilist knows that low fuel and maintenance bills measure his ability as an operator.

He takes pride in the "wear" he secures from his oil—in the silent and steady power which it yields—in his freedom from repair and carbon troubles.

There will always be some motorists who maintain their cars in a haphazard way.

But among motorists who recognize the dangers of inefficient lubrication our Chart of Automobile Recommendations has now become a standard guide.

In this chart the careful motorist finds specified for his car, the grade of Gargoyle Mobiloils whose *quality* is beyond question and whose *body* is scientifically-correct for his motor.

If your car is not listed, a complete Chart will be sent you on request.

In buying Gargoyle Mobiloils from your dealer, it is safest to purchase in original packages. Look for the red Gargoyle on the container.

The four grades of Gargoyle Mobiloils for gasoline motor lubrication, purified to remove free carbon, are:

**Gargoyle Mobiloil "A"**
**Gargoyle Mobiloil "B"**
**Gargoyle Mobiloil "E"**
**Gargoyle Mobiloil "Arctic"**

For information, kindly address any inquiry to our nearest office.

GARGOYLE

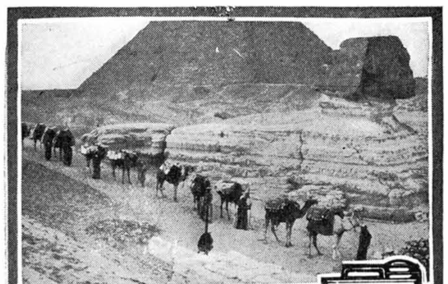
**Mobiloils**

*A grade for each type of motor*

**VACUUM OIL COMPANY,** **Rochester, N. Y., U. S. A.**

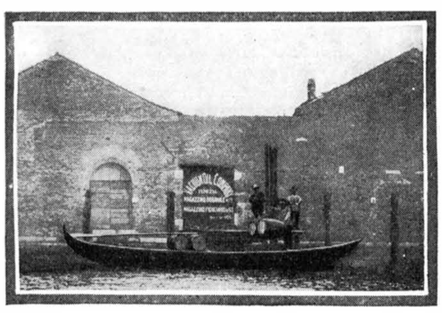
**Specialists in the manufacture of high-grade lubricants for every class of machinery. Obtainable everywhere in the world.**

*DOMESTIC BRANCHES:* Detroit, Boston, New York, Chicago, Philadelphia, Indianapolis, Minneapolis, Pittsburg

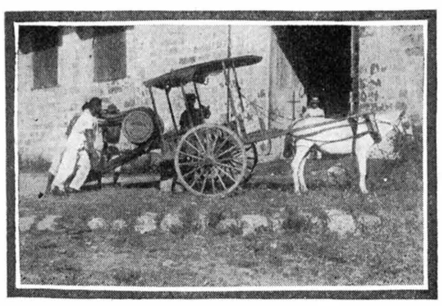


CARRYING GARGOYLE LUBRICANTS BY CARAVAN

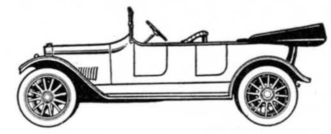
KOREANS DELIVERING OUR LUBRICANTS



GARGOYLE LUBRICANTS WAREHOUSE IN VENICE



TRANSPORTING GARGOYLE LUBRICANTS IN MANILA

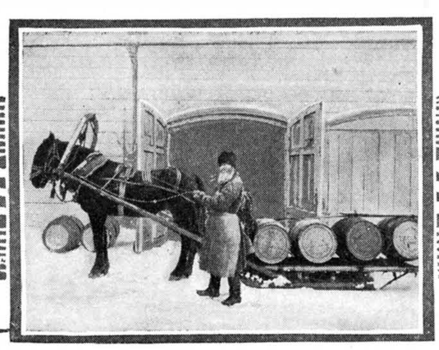


### Correct Lubrication

***Explanation:*** In the schedule, the letter opposite the car indicates the grade of Gargoyle Mobiloils that should be used. For example "A" means Gargoyle Mobiloil "A." "Arc" means Gargoyle Mobiloil "Arctic." For all electric vehicles use Gargoyle Mobiloil "A" for motor and enclosed chains. For open chains and differential use Gargoyle Mobiloil "C." The recommendations cover all models of both pleasure and commercial vehicles unless otherwise noted.

| MODEL OF | 1911 | | 1912 | | 1913 | | 1914 | | 1915 | |
|---|---|---|---|---|---|---|---|---|---|---|
| CARS | Summer | Winter | Summer | Winter | Summer | Winter | Summer | Winter | Summer | Winter |
| Abbott Detroit | A | Arc. | A | Arc. | A | Arc. | Arc. | Arc. | .... | .... |
| Alco | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | .... | .... | .... | .... |
| American | A | Arc. | A | Arc. | A | Arc. | A | Arc. | .... | .... |
| Apperson | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. |
| Auburn (4 cyl) | A | A | A | A | A | A | A | A | A | Arc. |
| " (6 cyl) | .... | .... | .... | .... | .... | .... | Arc. | Arc. | Arc. | Arc. |
| Autocar (2 cyl.) | A | Arc. | A | Arc. | A | Arc. | A | Arc. | A | Arc. |
| " (4 cyl.) | A | Arc. | A | Arc. | .... | .... | .... | .... | .... | .... |
| Avery | A | E | A | A | A | A | A | A | A | A |
| " (Model C) 1 Ton | .... | .... | .... | .... | .... | .... | Arc. | Arc. | Arc. | Arc. |
| Buick | A | Arc. | A | Arc. | A | Arc. | A | Arc. | Arc. | Arc. |
| Cadillac | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | .... | .... |
| " (8 cyl) | .... | .... | .... | .... | .... | .... | .... | .... | Arc. | Arc. |
| Cartercar | A | E | A | E | A | E | Arc. | Arc. | Arc. | Arc. |
| " Com'l | A | Arc. | A | Arc. | A | Arc. | .... | .... | .... | .... |
| Case | A | A | A | Arc. | A | Arc. | A | Arc. | A | Arc. |
| Chalmers | A | Arc. | Arc. | Arc. | Arc. | Arc. | A | A | Arc. | Arc. |
| Chandler | .... | .... | .... | .... | .... | .... | Arc. | Arc. | Arc. | Arc. |
| Chase (air) | B | B | B | B | B | B | B | B | B | B |
| " (water) | .... | .... | .... | .... | .... | .... | Arc. | Arc. | Arc. | Arc. |
| Chesterfield six | .... | .... | .... | .... | .... | .... | .... | .... | A | Arc. |
| Chevrolet | .... | .... | .... | .... | A | A | A | Arc. | Arc. | Arc. |
| Cole | A | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. |
| Cunningham | A | A | A | A | A | A | Arc. | Arc. | Arc. | Arc. |
| Delaunay-Belleville | B | A | B | A | B | A | B | A | .... | .... |
| Detroiter | .... | .... | A | Arc. | A | Arc. | A | A | A | Arc. |
| " (8 cyl) | .... | .... | .... | .... | .... | .... | .... | .... | Arc. | Arc. |
| Dodge | .... | .... | .... | .... | .... | .... | .... | .... | E | E |
| E. M. F. | Arc. | Arc. | Arc. | Arc. | .... | .... | .... | .... | .... | .... |
| Empire | A | Arc. | A | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. |
| Fiat | B | A | A | A | B | A | B | A | B | A |
| Flanders | E | E | Arc. | Arc. | .... | .... | .... | .... | .... | .... |
| " (6 cyl.) | .... | .... | .... | .... | Arc. | Arc | .... | .... | .... | .... |
| Ford | E | E | E | E | E | E | E | E | E | E |
| Franklin | A | Arc. | A | Arc. | A | Arc. | A | A | A | A |
| " Com'l | B | A | A | Arc. | A | Arc. | .... | .... | .... | .... |
| Garford | A | E | Arc. | Arc. | Arc. | Arc. | .... | .... | .... | .... |
| " Com'l | A | Arc. | Arc. | Arc. | Arc. | Arc. | A | A | .... | .... |
| Grant | .... | .... | .... | .... | .... | .... | Arc. | Arc. | Arc. | Arc. |
| Havers | A | Arc. | A | Arc. | A | Arc. | A | A | .... | .... |
| " (Model 6-60) | .... | .... | .... | .... | .... | .... | Arc. | Arc. | .... | .... |
| Haynes | A | Arc. | A | Arc. | A | Arc. | A | Arc. | A | Arc. |
| Hudson | A | Arc. | A | Arc. | A | Arc. | Arc. | Arc. | Arc. | Arc. |
| Hupmobile | .... | .... | .... | .... | A | Arc. | A | Arc. | A | Arc. |
| " (Model 20) | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | .... | .... | .... | .... |
| I. H. C. (air) | .... | .... | .... | .... | B | A | B | A | B | A |
| " (water) | .... | .... | .... | .... | A | A | A | A | A | A |
| International | B | B | B | A | .... | .... | .... | .... | .... | .... |
| Interstate | A | Arc. | A | Arc. | A | Arc. | .... | .... | .... | .... |
| Jackson | A | Arc. | A | Arc. | A | Arc. | Arc. | Arc. | Arc. | Arc. |
| Jeffery | .... | .... | .... | .... | .... | .... | A | A | A | Arc. |
| Kelly Springfield | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | A | A | A | A |
| King | A | E | A | E | A | E | A | A | A | Arc. |
| " (8 cyl) | .... | .... | .... | .... | .... | .... | .... | .... | Arc. | Arc. |
| Kissel Kar | A | Arc. | A | Arc. | A | Arc. | A | Arc. | A | Arc. |
| " " Com'l | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | A | Arc. | A | Arc. |
| " " (Model 48) | .... | .... | .... | .... | .... | .... | A | A | A | A |
| Kline Kar | Arc. | Arc. | Arc. | Arc. | Arc. | Arc | A | Arc. | A | Arc. |
| Knox | B | A | B | A | B | A | B | A | B | A |
| Krit | A | A | A | A | A | A | A | A | A | Arc. |
| Lippard Stewart | .... | .... | Arc. | Arc. | Arc. | Arc. | Arc | Arc. | Arc. | Arc. |
| Locomobile | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | E | E | E | E |
| Lozier | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | A | Arc. | .... | .... |
| Lyons Knight | .... | .... | .... | .... | .... | .... | A | A | B | A |
| Mack | A | E | E | E | E | E | A | E | A | E |
| " (Model S) | .... | .... | .... | .... | A | A | A | A | A | A |
| Marion | A | E | A | Arc. | A | Arc. | Arc. | Arc. | Arc. | Arc. |
| Marmon | A | Arc. | A | Arc. | A | Arc. | A | Arc. | A | Arc. |
| Maxwell | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. |
| Mercer | A | Arc. | A | Arc. | A | Arc. | A | Arc. | A | Arc. |
| " (22-70 Series) | .... | .... | .... | .... | .... | .... | .... | .... | Arc. | Arc. |
| Metz | B | Arc. | A | Arc. | A | Arc. | A | Arc. | A | Arc. |
| Mitchell | A | Arc. | A | Arc. | A | Arc. | A | Arc | A | Arc. |
| Moline | A | Arc. | A | Arc. | A | Arc. | .... | .... | .... | .... |
| " Knight | .... | .... | .... | .... | .... | .... | A | A | A | A |
| Moon (4 cyl.) | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | A | Arc. | Arc. | Arc. |
| " (6 cyl.) | .... | .... | .... | .... | .... | .... | Arc. | Arc. | Arc. | Arc. |
| National | A | A | A | A | A | A | A | A | A | Arc. |
| Oakland | A | Arc. | A | Arc. | A | Arc. | Arc. | Arc. | Arc. | Arc. |
| Oldsmobile | A | Arc. | A | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. |
| Overland | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. |
| Packard | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | A | Arc. | A | Arc. |
| Paige | A | Arc. | A | E | A | E | A | A | A | Arc. |
| " (6 cyl) | .... | .... | .... | .... | .... | .... | .... | .... | Arc. | Arc. |
| Pathfinder | .... | .... | .... | .... | A | Arc. | Arc. | Arc. | Arc. | Arc. |
| Peerless | Arc. | Arc. | Arc. | Arc. | Arc. | Arc | Arc. | Arc. | Arc. | Arc. |
| Pierce Arrow | A | Arc. | A | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. |
| " " Com'l | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc | Arc | Arc. | Arc. |
| Pope Hartford | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | .... | .... |
| Premier | A | Arc. | A | Arc. | A | Arc. | A | Arc. | A | Arc. |
| Rambler | A | Arc. | Arc. | Arc. | Arc. | Arc. | .... | .... | .... | .... |
| Regal | A | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. |
| Renault | A | Arc. | A | Arc. | A | Arc. | A | Arc. | .... | .... |
| Reo | A | Arc. | A | Arc. | A | Arc. | A | Arc. | A | Arc. |
| S. G. V. | B | Arc. | B | Arc. | B | Arc. | A | Arc. | A | Arc. |
| Saurer | A | Arc. | A | Arc. | A | Arc. | Arc. | Arc. | Arc. | Arc. |
| Saxon | .... | .... | .... | .... | .... | .... | E | E | E | E |
| Selden | A | E | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. |
| Simplex | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. |
| Speedwell | A | Arc. | A | Arc. | Arc. | Arc | Arc | Arc. | Arc. | Arc. |
| " Mead | .... | .... | .... | .... | A | Arc. | B | A | B | A |
| Stearns | A | Arc | A | Arc. | .... | .... | .... | .... | .... | .... |
| " Knight | .... | .... | A | A | A | A | B | A | B | A |
| " " (Light 4) | .... | .... | .... | .... | .... | .... | .... | .... | A | Arc |
| Stevens Duryea | Arc. | Arc. | Arc. | Arc. | Arc. | Arc | Arc. | Arc. | Arc. | Arc |
| Stoddard-Dayton | A | A | A | A | A | A | .... | .... | .... | .... |
| " " Knight | .... | .... | A | A | A | A | .... | .... | .... | .... |
| Studebaker | A | Arc. | Arc. | Arc. | A | Arc. | A | Arc. | Arc. | Arc. |
| Stutz | .... | .... | Arc. | Arc. | Arc. | Arc. | A | A | A | A |
| Velie (4 cyl.) | A | Arc. | A | Arc. | A | Arc. | A | Arc. | A | Arc. |
| " (6 cyl.) | .... | .... | .... | .... | .... | .... | Arc. | Arc. | Arc. | Arc. |
| Walter | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | A | A |
| White | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. |
| Willys Knight | .... | .... | .... | .... | .... | .... | A | A | B | A |
| " Utility | .... | .... | .... | .... | .... | .... | A | Arc. | Arc. | Arc. |
| Winton | Arc. | Arc. | Arc. | Arc. | Arc. | Arc | Arc. | Arc. | Arc. | Arc. |


VACUUM OIL CO., BANGKOK, SIAM



SLEDGE DELIVERY IN MOSCOW


VACUUM OIL COMPANY, PORTUGAL

GARGOYLE LUBRICANTS IN INDIA

# SCIENTIFIC AMERICAN

VENETIAN TOWERS AT THE PANAMA-PACIFIC EXPOSITION AT NIGHT.—[See page 378.

Vol. CXII. No. 17
April 24, 1915

Munn & Co., Inc., Publishers
New York, N. Y.

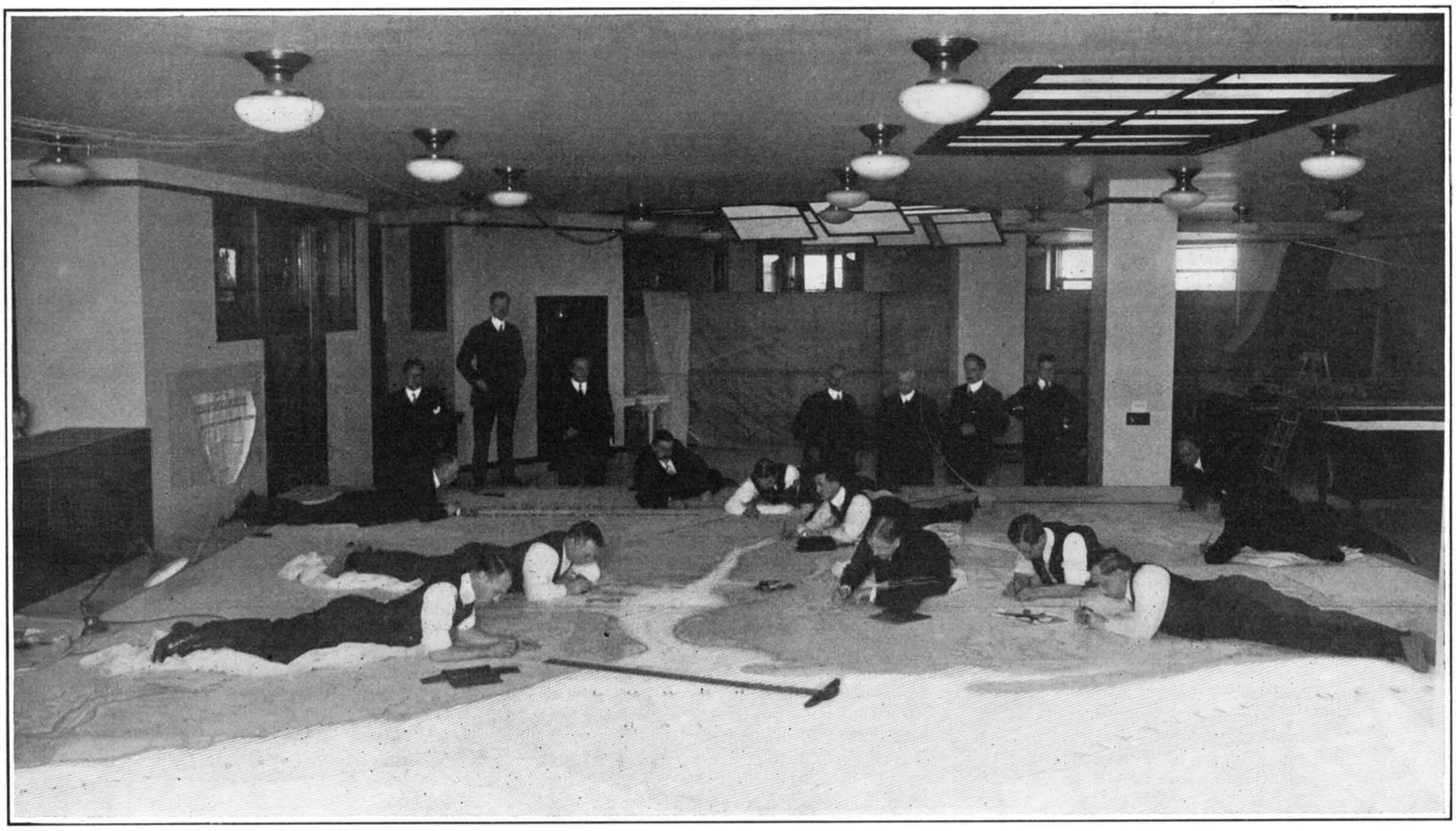
Price 10 Cents
$3.00 A Year

SEVENTY-FIRST YEAR

SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

VOLUME CXII. NUMBER 17. | NEW YORK, APRIL 24, 1915 | 10 CENTS A COPY $3.00 A YEAR



Piecing together the big map of New York city. Note the felt slippers and sheets used by the draftsmen.

## New York City's Twenty-five Foot Map

By Charles W. Person

A GREAT map twenty-five feet wide, representing every street, park, harbor, island, lake, county and State line, railroad and steamship pier, and every topographical detail of Greater New York, has just been finished. One look at the new map is enough to convince you that 326.83 square miles is quite an area to represent on paper, especially when that area is one vast network of streets, parks, waterways, islands, and piers. By exact measurement the map is 25 feet wide and 25¾ feet long. The scale is 1 inch to 600 feet, which means that close to 1,200 square miles is included. Staten Island extends so far to the southwest that a large piece of New Jersey and many square miles of water have to be included in this map if it is to be put on a rectangular sheet. A reproduction of this map is being made on the scale of 1 inch to 1,000 feet, while another, on the scale of 1 inch to 2,000 feet, will be sent to the San Francisco Exposition. New Yorkers who wouldn't look at it at home may be interested in it out there.

It was three years ago that Nelson P. Lewis, chief engineer of the Board of Estimate, undertook to have a new map of the city made. There were official maps on hand at the time, such as the map prepared by the original Commissioners of New York in 1807, the Brooklyn village maps of 1819 and 1839, and the surveys of Kings County made in 1876, and, of course, there were innumerable maps privately printed. But what Mr. Lewis set out to do was to make a perfect map of the greater city which infringed no copyright. He gathered his material from the Borough Presidents, who have charge of the topographical records of their districts; from the Department of Docks and Ferries, and from the Street Cleaning Department. He obtained assistance from the States of New York and New Jersey and the United States Government. The railroad companies helped him with stations, routes, etc. All this information was assembled under the direction of the chief draftsman.

The first work of the draftsmen was to divide the city into sections and make preliminary maps of each section. After these had been tested and proven they were transferred to the final map. Here was where accuracy was put to a real test. It was found that the use of a pantograph would be too long and expensive, and photography, because of astigmatism of lenses, was not to be trusted. Thus it was that the chief draftsman, James A. Faust, rigged up tables each big enough to hold a section of the map, fitted glass to the top of each table, and placed four lamps of 70-watt power below the glass.

The preliminary map was put on top of the table and the anvil paper of the final map was laid on top of it. The light shining from beneath was so powerful that tracing was easy. Tracing cloth was not used at all, for the reason that it is so greatly affected by the weather.

It was discovered long before this tracing work was begun that the final map would be too big to be made and kept in one piece. There wasn't a room in the Municipal Building large enough to hold it. There was just one room, however, where the draftsmen had space enough to build a platform 28 feet square to hold the twenty-one sections which, when joined together, form the great map.

When the sections were completed there was the interesting task of assembling them and fitting them together perfectly. It was then that the city had to buy eighteen pairs of soft, felt slippers and white sheets for the men. A man would creep out on the map in his soft, clean slippers, to his particular section, spread a sheet before him, lie down on it, and then see if the north end of Brooklyn fitted exactly to the south end of Long Island City. It was nervous work, this shifting about on the big map, when a dig of the elbow might have obliterated work that would take hours to replace, or a quick turn might have overturned a bottle of ink.

There were some parts of Manhattan where it required nine hours' work to complete a section two inches square, and the draftsman who executed the large and handsome title in the northwest corner did nothing else but work on that title from nine in the morning to ten-thirty at night for a period of six months.

## Scholarship for Belgian Students in American Universities

A MOVEMENT is on foot to assist in bringing to America worthy, intellectual men and women for a temporary free enjoyment of the privileges of American institutions. Assurances have already been received from the George Washington University for the instruction of ten students in any of the departments of the University, free tuition to the extent of $1,500 being furnished to European college students who are not able to pursue their courses owing to present conditions. It is estimated that between $20,000 and $25,000 will be required to defray the traveling expenses from and to Belgium and the cost of residence in Washington for a period of one year. The Belgian Scholarship Committee, which is a sub-commitee of the Central Committee for the Belgian Relief Fund, is endeavoring to raise this amount. Checks should be drawn payable to the Belgian Scholarship Committee, John Joy Edson, treasurer, Washington Loan and Trust Building, Washington, D. C.

## Substitute for Wood in Pattern-making

A COMPOSITION that has many advantages over wood for making small patterns can be made as follows: With hot water mix into a thick paste three parts by volume of starch, one part ground glue, two parts fine resinous sawdust. The sawdust should not be added until the starch and glue have been dissolved by the water. After the ingredients are thoroughly mixed, heat the whole to 190 deg. Fahr. and continue the heating until the whole becomes a hard mass, then allow to cool and remove from the receptacle. The resulting composition is a strong, hard, horn-like substance that can be machined, sandpapered, and varnished the same as wood.

The principal advantages of this composition over wood lie in the fact that it has no grain, and therefore turned and complicated patterns made from it do not have to be built up or glued together, and that for the same reason it is easier to turn and machine, and offers a smoother surface when finished. It is also more fireproof than wood and not so readily affected by atmospheric changes.

# SCIENTIFIC AMERICAN

**Founded 1845**

**NEW YORK, SATURDAY, APRIL 24, 1915**

Published by Munn & Co., Incorporated. Charles Allen Munn. President; Frederick Converse Beach, Secretary; Orson D. Munn. Treasurer; all at 233 Broadway, New York

Entered at the Post Office of New York, N. Y., as Second Class Matter
Entered as Second Class Matter at the Post Office Department, Canada.

Trade Mark Registered in the United States Patent Office



**Subscription Rates**

| | |
|---|---|
| Subscription one year................................ | $3.00 |
| Postage prepaid in United States and possessions. Mexico, Cuba, and Panama | |
| Subscriptions for Foreign Countries, one year, postage prepaid, | 4.50 |
| Subscriptions for Canada, one year, postage prepaid......... | 3.75 |

**The Scientific American Publications**

| | |
|---|---|
| Scientific American (established 1845)..........per year. | $3.00 |
| Scientific American Supplement established 1876. " " | 5.00 |
| American Homes and Gardens................ " " | 3.00 |

The combined subscription rates and rates to foreign countries including Canada, will be furnished upon application.
Remit by postal or express money order, bank draft or check

**Munn & Co., Inc., 233 Broadway, New York**

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp* the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

*The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.*


## Blockade by Submarine

WE deferred any editorial discussion of the so-called submarine blockade of the British Isles until the experiment had been under trial for a sufficient time to prove whether or no it is entitled to be called a blockade or should be designated by some other name less euphemistic.

The attempted blockade has now been carried on for sufficient time to prove that, so far as the submarine effort coming within the universally accepted definition of a blockade is concerned, it has been a complete fiasco.

A blockade, in the sense that has been established in the past history of the world, and in the present accepted meaning of that term, consists in establishing a cordon of ships around the sea approaches to an enemy's coast, so strong and effective as to prevent the passage of merchant ships to or from that country, carrying certain articles of commerce which are known as contraband of war.

Have the German submarines done this? The answer to that question is found in the statistics of British maritime commerce, which show that during the period in which this German experiment has been tried, only 2 or 3 per cent of the shipping which has entered or cleared from the British Isles has been intercepted and sunk.

Not only does this raiding of merchant shipping fail utterly to achieve the results which alone would entitle it to be dignified by the name of blockade, but it is also debarred from the use of that title by the fact that, in their method of carrying out the raid, the German Admiralty are deliberately violating those humanitarian laws which have been adopted for the purpose of mitigating the horrors of war, so far as they affect non-combatants.

In previous wars it has been the universal practice, when an enemy's ship which was carrying contraband was intercepted by the blockading vessels, either to take the vessel into port and confiscate her cargo, or, if this were impossible, to remove her crew and passengers and sink the ship upon the high seas. Always, care has been taken to safeguard the lives and persons of the non-combatants.

Now a submarine, in the very nature of things, being able to afford accommodations only for her crew, is unable to take aboard the non-combatants from the captured ships. Also, because of the risk to herself from enemy warships, she will rarely be in a position to take the ship into port. Because of the risk of detection, it will be impossible to make the usual examination of the ship's cargo, at the time she is held up, to determine whether there is contraband aboard.

These being the conditions, it follows that when the German Admiralty determined to institute this system of sinking any ship encountered in the so-called "war zone" they deliberately threw overboard all humanitarian considerations, and put themselves to that extent outside the pale of modern civilization.

No amount of labored casuistry can relieve them from this fearful responsibility. The question of their moral accountability stands or falls quite independently of anything which the Allies may themselves be doing. There is a sound old adage which says that two blacks never made a white. Germany has developed some very remarkable cases of moral self-delusion during the present war, and certainly the most conspicuous instance of this is her attempt to justify this practice of sinking all shipping in the enemy's waters on sight, without first determining whether it is carrying contraband of war or not, and without making any provisions whatsoever for saving the lives of non-combatants. It is mere casuistry to state that this practice is justified by the fact that the Allies are preventing foodstuffs from reaching Germany. The Allies are not sinking ships on sight; on the contrary, they are capturing them and taking them to port, or, if they should sink them, they are making every provision to save the lives of non-combatant passengers and crew. The cases are not in the least sense parallel and nowhere is this better understood than by the German Admiralty itself.

If the German submarines are to become effective in striking a vital blow during the present war, why does not the Admiralty send them out to sink the great British transports which come and go, apparently with impunity, between Great Britain and France? If the German submarine flotillas directed their activities against these ships, they would be keeping well within the sphere of legitimate warfare, and they would be striking a badly-needed blow for the relief of the hard-fighting armies of Germany in the western theater of war.

## The War of Attrition

IN any discussion, anterior to the war, of possible conflict between Germany and Great Britain, the numerical superiority of the British fleet was accepted and great stress was laid upon the preliminary war of attrition, by which the margin of superiority of the British fleet was to be so worn down as to render it possible for the German main fleet to accept battle with an even chance of victory.

In accordance with this expectation, or policy, Germany paid particular attention to the development of what might be called the minor units of her fleet. Thus she built up her destroyer flotillas to a high standard both in numbers and efficiency; and it is notorious that the careful selection of officers for the command of her destroyers and the nature of the maneuvers in which they were constantly engaged, had brought this arm of the service up to a point of efficiency which was not surpassed in any other navy.

In the earlier years of its development, Germany looked askance at the submarine; and, for once, the astuteness of the Germans in recognizing any invention which had shown promise of practical development, seems to have failed them. For it is a fact that Germany entered the field of submarine construction rather late in the day; though it must be admitted that, having once taken hold of the problem, she has developed vessels of this class which are as good and, probably, because of Germany's excellent work in the field of oil motors, a little better than those of other countries.

Consistently with her policy, Germany from the outset of the war, concealing her main fleet behind the mine fields guarding her harbors, has sought to carry into effect her policy of attrition. And it must be admitted that she started out very well indeed, for the sinking of the three large armored cruisers, "Cressy," "Aboukir," and Hogue," in the early months of the year seemed to foretell a steady diminution of the strength of the enemy—a forecast which was subsequently substantiated by the loss of the pre-dreadnought "Formidable" and, possibly, of the dreadnought "Audacious."

The subsequent actions in which it came to be engaged, however, have shown the destroyer fleet of Germany to be shorn of its terrors; for these craft have fared badly at the hands of the enemy, and, so far as it has been officially announced, they have not, thus far, accounted for a single ship of importance. It is chiefly the mine and the submarine that have been responsible for such diminution of the forces of the enemy as has occurred.

After nine months of war, so far from Great Britain having lost any of her numerical superiority, her gains have greatly exceeded her losses, and she is much stronger to-day than when the war started. Her main fleet has been increased by the addition of several ships of the "Queen Elizabeth" class, any one of which, in a rating of its fighting value, would more than offset the total naval losses of Great Britain since the war began. According to the reports of the First Sea Lord, the strength of the main fleet of the British navy is growing at the rate of a dreadnought per month—a statement which seems to be borne out by a study of the naval programme and by the speed of construction in the government and private yards of Great Britain at the time when war was declared.

Furthermore, it is a question whether the attrition has not been as great on the side of Germany as on that of Great Britain. The fine armored cruiser "Bluecher" may fairly well be set off in value against the old battleship "Formidable," and surely the "Scharnhorst" and "Gneisenau" represented a greater fighting value than the three old armored cruisers "Cressy," "Aboukir," and "Hogue." True, there is the "Audacious"; but it must be admitted that there is at least a reasonable doubt as to whether that ship, badly hurt as she was, really went to the bottom.

Furthermore, in addition to the three German armored cruisers above mentioned, there are two older vessels of this class that have been lost, the "Yorck" and "Friedrich Karl." To these must be added the light cruisers, "Magdeburg," "Köln," "Mainz," "Emden," "Dresden," "Nurnberg," "Königsberg," and "Leipzig," all of them among the best of their class afloat.

The loss in ships is equalled by the loss in men, and a naval writer in the *Naval and Military Record*, basing his estimate of the complement of these ships, as contained in the German publication *Nauticus*, arrives at a total estimate of 8,550 men in the ships which have already been lost. A certain proportion of these officers and men was saved, but it is fairly certain that the lesses represent over 10 per cent of the total *personnel* in the German navy.

## Rational Research

THE small fraction of mankind which controls the destinies of the whole is fully aware of the advantages that spring from increasing knowledge. These advantages have been attested by centuries of experience, so that the quest of truth is no longer mere obedience to a primordial instinct, but a deliberate and reasoned attempt to ameliorate the human lot, physically as well as intellectually. Yet not only is the amount of human energy devoted to the increase of knowledge insignificant in comparison to that expended on other objects—as, for example, the conservation of knowledge that is doubtfully worth conserving—but the customary methods of acquiring fresh information are flagrantly uneconomical, because utterly devoid of system.

The Carnegie Institution of Washington is the most prolific research agency extant. Its importance, however, as a factor in human progress is by no means to be measured merely by its direct contributions to knowledge. This institution—or, properly speaking, its sagacious director—has made the capital discovery that the most serious problem with which such an agency has to deal is not one of physics, or astronomy, or biology, or the like, but rather of what, in the absence of any more familiar name, we shall call "heuristics." In other words, such an establishment is called upon, first and foremost, to ascertain the most effective methods of applying its resources to the promotion of research, and this problem is a far more difficult one than might appear at first sight.

The fallacies that have hitherto prevailed as to the functions of research institutions in general, and of the munificently endowed Carnegie Institution in particular, were set forth last summer by Director Woodward in an address which has evoked many echoes at home and abroad. This eloquent address, delivered at the dedication of the Woods Hole Marine Biological Laboratory, was perhaps the first complete formulation or crystallization of ideas developed in the course of the speaker's experience at the head of the Carnegie Institution, and some of these ideas are further developed and reinforced in the latest yearbook of the Institution, just published.

Dr. Woodward refers to "the widely spread, if not prevalent, assumption that research establishments are mere disbursing agencies, waiting for suggestions of appropriate ways in which to apply funds." Such has, indeed, been the prevalent assumption, not only among laymen, but also among men of science. In contrast to this doctrine is the one to which the Carnegie Institution is now unreservedly committed, viz., that "it should be the primary purpose of a research institution *to institute and to conduct research.*"

To quote again: "Another popular illusion is that research establishments should busy themselves in casting drag-nets in the wide world of thought, or dredging, as biologists would say, with the expectation that out of the vast slimy miscellanies thus collected there will be found by the aid of a corps of patient examiners some precious sediments of truth"; and this despite the recognized fact that "the doors are thus opened to the hosts of amateurs, dilettanti, and paradoxers who stand ready to waste the time and the resources of research establishments in the pursuit of the obvious, the futile, and the demonstrably unattainable" (to say nothing of downright quacks and charlatans).

The Carnegie Institution has fully satisfied itself that this "drag-net" method, still highly favored by many persons of intelligence, is about the most wasteful way in which such an institution can employ its time and money.

It can hardly be doubted that the Carnegie Institution, in limiting its grants to persons whose fitness for research undertakings has been most rigorously demonstrated; in devoting the major part of its resources to certain large problems, the investigation of which is entrusted to corps of permanently employed experts; and especially in inaugurating lines of work of its own motion, has set an example that will hereafter be widely followed.

## Science

**Camphor in the Philippines.**—It is reported that Blumea balsamifera which grows wild in abundance in the Philippines, has been found to be identical with the plant from which *ngai* camphor is obtained in certain parts of China. The commercial possibilities of this plant are now being investigated by the Philippine Bureau of Science and Bureau of Forestry.

**The Kuskokwim River,** the second largest river in Alaska, is about to be opened to commerce in consequence of the discovery, by Capt. Lukens of the Coast and Geodetic Survey, of a navigable channel in its extensive and hitherto little known delta. The river itself is navigable for a distance of 600 miles from its mouth, and is thus destined to make accessible a very promising mining, fishing and agricultural region.

**A School of Forestry in China.**—It is notorious that afforestation is one of the most urgent of China's needs, and it is therefore of interest to learn that a school of forestry is about to be established in the University of Nanking. The co-operation of the director of forestry at Manila has been secured, and it is proposed to send two experts from Manila to aid in establishing the school.

**Climate and Efficiency.**—It is estimated by the Los Angeles Chamber of Commerce that labor is twenty per cent more efficient in and about the Southern California metropolis than in eastern cities, where extreme temperatures affect a man's working capacity. Holding that climate is one of the most far-reaching of all factors which influence industrial progression, the Chamber officials state, in a recent bulletin:

"It affects labor efficiency, it regulates the comfort and the cost of living, it influences the cost of building construction, it controls manufacturing possibilities, it determines the number of possible operating days within a year and it governs the cost of production. Figuring on a basis of 20 per cent added labor efficiency, Los Angeles' climate would increase the actual labor assets of Pittsburgh more than $300,000,000 per year. This is because of the almost entire absence of humidity, oppressive heat and extreme cold."

**Tinned Cheese.**—In this age of "sanitary" packages for food products, it is an anomaly that we still buy our cheese by the pound, sliced off from a common loaf at the grocers. For a number of years the U. S. Department of Agriculture has been testing the merits of cheese put up in air-tight tins, and the results are said to be satisfactory. It is found commercially practicable to press cheese of the Cheddar type in hoops of small diameter, cut it into pieces of the desired weight, and seal it in the tins. This process not only conduces to the preservation of the product, but also prevents loss by evaporation and the waste entailed in cutting. Moreover, the tinned cheese has no rind, and this fact represents a gain which helps to offset the cost of tinning, estimated at about 3 cents for labor and tins.

**The Psychology of Practice.**—The question of short *versus* long periods of practice in training the human muscles for any particular kind of work is obviously one having far-reaching application. Some interesting experiments on this subject have been carried out by Dr. K. S. Lashley, of John Hopkins University. Acquisition of skill in archery was selected as the subject of observation. Twenty untrained persons were divided into three groups. One group shot 5 arrows with the English longbow per day; another, 20 shots per day; and the third, 40 shots. The results showed conclusively that the group shooting only 5 times a day improved in accuracy with less expenditure of time in practice than was required by either of the other groups for the same amount of improvement. A report on the experiments says: "The relatively greater efficiency of short periods of practice continuing for many days is in accordance with the results of the study of animals and of speech habits in man, and indicates that in training to muscular feats, in both animals and men, the *length of practice periods required is usually too great for maximum efficiency.*"

**The Study of Atmospheric Electricity** which has been generally neglected in this country, is destined hereafter to form a prominent feature of the work of the Carnegie Institution's Department of Terrestrial Magnetism. The last annual report of the directors calls attention to the important articles by which Dr. Swann published during the past year in *Terrestrial Magnetism*, which have brought out new points in the theory of this subject and also led to notable improvements in apparatus and methods of measurements. The Department now announces that its work in this field is to be expanded in two directions; viz., (1) continuous observations, by self-registering instruments, in atmospheric electricity and radio-activity, both at the laboratory in Washington and at such observatories elsewhere as it may be found possible to establish; and (2) a general electric survey of the globe, implying observations at points distributed over the earth's surface, somewhat as in a magnetic survey. The latter undertaking has often been suggested in the past, and is undoubtedly an urgent desideratum, assuming that there is now general agreement as to the proper methods of observations.

## Automobile

**A Novel Tire Repair Stud.**—Hugh Taylor Stephens, of Carmarthen, Wales, in a patent No. 1,131,745, shows a small puncture mending device having a stem to extend through the tire, a disk at one end of the stem and an inverted cup at the other end of the stem, and adapted to be pressed down to clamp the tire against the end disk.

**Novel Pocket Screwdriver.**—Motorists are sometimes in need of a screwdriver for instant use, and hate to stop the car, dig into the tool box for the big screwdriver and waste five or ten minutes in the operation. For these there has been invented the "Pocket Screwdriver" which is really nothing but a circular piece of steel, the size of a quarter, tapered along the rim, so as to "take" any size or type of screw.

**Differential Locks for War Trucks.**—One of the lessons learned during the present war has been that of having either a four-wheel drive truck or a differential lock. When one of the rear wheels becomes mired in soft ground, it behooves the driver to lock the differential immediately, in order to get the truck out of the mud. Several good trucks have been lost because of the driver's inability to get the wheels to grip the ground.

**Damages for a Broken Footboard, $10,000.**—A most unusual case has just been decided in Buffalo, N. Y., in favor of a little girl who, in jumping over the back seat of her father's automobile broke through the footboards, entangling her right leg in the machinery. The leg had to be amputated. After listening to the testimony of manufacturers and carpenters, the jury decided that the maker of the automobile was responsible for the accident and awarded the girl $10,000 damages. The case has been pending since 1909.

**Where the Slowest Lead.**—When motor trucks loaded with ammunition are despatched to the front, from a depot in the rear of the firing lines, it is now self-understood that the slowest trucks go in front, while the fastest bring up the rear. This was found necessary because of the tendency of ammunition drivers to go at top speed, when the call for shells and cartridges comes. If the slow trucks are in the rear of the column, the latter is strung out over miles of road, with great gaps between trucks—offering an inviting target for an attack by reconnoitering armored motor cars or cavalry.

**London Buses Are Still Running.**—According to the figures issued by the London traffic police, there were at the end of March 2,029 motor omnibuses again in service in Great Britain's capital. It is stated that more and more buses are withdrawn from the continent for regular service in the city, and new trucks are being installed for the military services of the country. The withdrawal of the buses from passenger traffic in the first two weeks of August was caused by the general unpreparedness of the British transportation service. This unpreparedness, it is announced, is now overcome.

**British Suggest 12-Cylinder Motor Car.**—While a 12-cylinder motor car is not exactly a novelty in Great Britain, the Sunbeam having appeared several years ago in this type, the latest suggestion among British motor car manufacturers as to 12-cylinder machines is worthy of special comment. It is nothing more or less than the fixing of the 12 cylinders in "arrowhead" form, that is to say with four cylinders standing vertical, and the others in two four sets at an angle of 45 degrees on either side of the vertical set. Such a motor would be exceedingly short and compact, requiring, despite its large number of cylinders, only a short hood.

**Less Crude Rubber this Year.**—Careful estimate of the quantity of sap collected so far from the rubber trees in South America, Africa and the East Indian plantations shows that there will be less crude rubber in 1915 than there was in 1914. The shortage may prove very serious at the beginning of next year, as the indications point to still smaller quantities in 1916. The crude rubber crop of 1914 amounted to 71,977 tons of plantation; 37,000 tons of Brazil, and 12,000 tons of miscellaneous caoutchouc—a total of 120,977 tons, representing an increase of 11.5 per cent over the 1913 crop. The figures for 1915 are given as (approximately): 85,000 plantation, 30,000 Brazil and 5,000 miscellaneous rubber, a total of 120,000 tons, or a decrease of almost 1 per cent.

**A Sectional Inner Tube.**—In an endeavor to solve the puncture problem, a New York inventor has brought out a sectional pneumatic tube—an idea which has occurred to more than one inventor. The tube consists of fifteen sections, each in itself a complete inner tube, not unlike a string of sausages. Each section is connected with the main valve, by a metal tube, within the rim. When a puncture occurs, the space formerly occupied by the punctured section is at once taken up by the two adjoining sections, which expand and maintain the air pressure in the tire. Tire experts who have examined the tube, are of the impression that if two adjoining sections should be punctured before the tire is renewed, the side pressure from the adjoining sections, in trying to fill up the vacant space, would be so strong as to tear out the valves of these sections.

## Notes for Inventors

**Extinguishing Automobile Fires.**—James B. Erwin and Orlando R. Erwin of Milwaukee, Wis., in patent No. 1,130,719 present a fire extinguishing process in which if a fire occurs in an automobile hood it will release a fire extinguishing liquid which will be discharged on the preheated motor surfaces and vaporized to fill the hood with a fire extinguishing gas.

**Sleeping Car Ventilation.**—The lower berth in a sleeping car is stuffy with the windows closed and if you open the window the cold air is directly on you. It is thought that the riding public would appreciate some deflector or diffusing construction which could be applied to the open window over the usual short hinged screen and permit the entry of fresh air, at the same time preventing it from blowing directly on the passenger in the berth.

**Improving the Tone of a Talking Machine.**—To eliminate the shrillness and deaden the metallic sounds of the talking-machine, a German inventor has just patented a principle of tone-protection that employs a lining of cocus-fiber for the cabinet, by which that is hermetically sealed, washers and other accessories of the same material for the phalanges of the tone-arm and all other points of metal contact and a fiber base for the record. He asserts that by this principle the surviving musical tone is immeasurably enhanced in quality.

**New Electric Bell.**—An original electric bell combination is in use at Paris which is designed to get rid of all trouble caused by the question of batteries, for these are now lodged within the apparatus itself. The usual box bell shape is retained, but the arrangement of the parts is different in this case. All the magnet parts are now lodged under the gong itself, while the box being now left free, serves to contain a set of three dry battery cells which will last for several years. In this way there are no connections to be made between the battery and bell, and the wires and push-button are the only pieces which need to be attended to.

**Door Fastener.**—Placing a wedge under a door is one of the most effectual means of closing it, for pushing upon the door from the outside only increases the effect of the wedge. A convenient device of this kind is made of metal, and it not only serves to wedge the door but also contains a mechanical bell mounted on the same base and behind the wedge in such way that pressure on the face of the wedge by the door causes the bell to ring. The base carries a set of short points underneath so that it can be put in place and grips upon the carpet or flooring so as not to slide out of position. Such a device can be carried in the pocket, and it is to be recommended for traveling.

**Pocket Atomizer.**—A recent novelty is a pocket atomizer in the shape of a watch. The head or top has a small orifice, and the spray is produced by pressing on the flexible metal sides. A miniature funnel is provided for the filling, which is done by unscrewing the head. Another atomizer consists of a small cylindrical pump mounted on a cork so as to fit into any bottle and thus avoid handling of the perfumes from one bottle to another. A plunger at the top serves to produce the spray from a side orifice. The tube which descends into the liquid has a second or telescoping end so that the tube can be extended down as far as the bottom of the bottle and thus take up all the liquid.

**A Combined Swab with the Medicament.**—In patent No. 1,131,575 to A. D. Tuttle of Washington, D. C., is provided a swab for surgical purposes formed of an absorbent material such as raw cotton provided with a suitable handle. Embedded in the swab is an easily broken glass bottle which contains the liquid it is desired to apply to the swab. The swab with the liquid can then be easily transported without danger of accidental breakage, and the container of glass can be readily broken when desired to permit the liquid to permeate the swab. The friable container is sealed and has no stopper and cannot waste its contents until intentionally broken. The swab will prevent the fragments of glass from causing any injury

**Paper Cartridge Cases.**—A new application of extreme interest at the present time of the metal sprinkling process invented by Mr. M. U. Schoop, an engineer of Zurich, consists in the manufacture of cartridge cases from metallized paper in lieu of brass or copper. The advantages of such a process are apparent even to the layman. A certain independence of the large quantities of brass and copper hitherto required is obtained. In addition to this, there is a saving in weight of three to four grammes in each cartridge, as a result of which the soldier can carry a considerably larger quantity of ammunition than heretofore. In the Schoop process the liquid metal is crushed by means of compressed air and is then inflated by any known method into extremely fine particles. Metallized cardboard or paper can in this way be provided with any durable and well adhering metal coverings of any desired thickness. For the purpose above mentioned very thin coatings of a few thousandth parts of a millimeter in thickness are of course sufficient.

**The Court of the Four Seasons at the Panama-Pacific Exposition illuminated by a battery of forty-eight 36-inch searchlights on a jetty in the harbor.**

# The Panama-Pacific International Exposition at Night

## How the Illuminating Engineer Uses Light Decoratively

By Hamilton M. Wright

TO the expert the lighting of the great exposition at San Francisco marks an epoch in the science of lighting and in the art of illumination. To the layman the illumination of the exposition is its most mystical and enthralling feature, and apart from its technical and scientific interest the illumination is a magnificent success. At night myriads of beams of light of changing colors cast a spell over the exhibit palaces at the Golden Gate.

The plan of illumination was undertaken with the idea of presenting the exposition at night in the same relative values of color and perspective in which it is observed by day. And the plan has worked out successfully. At night the architectural details of the exhibit palaces are intensified; the beauty of the sculpture is enhanced, and under the plan of diffused and projected light the more important details of the sculpture are emphasized. There are no black shadows to modify the intent of the sculptor, and the inspiring psychological effect produced upon the visitor by the vast fields of melting riotous colors under the brilliant California sun becomes intensified at night; the exposition becomes more resplendent.

The most conspicuous objective of the lighting plan is the lofty Tower of Jewels, 435 feet in height. This monumental sculptured pile when played upon by hundreds of concealed searchlights stands out like a vast terraced pyramid of ivory, almost satin white, with the minute details of its architecture limned against the dark heavens.

The result sought in the illumination was, as before suggested, to co-ordinate the artificial lighting with the colors of the exposition and with those provided by nature in the shrubbery and landscaping upon the exposition grounds (an object representing the highest artistic effort of which the illuminating engineer is capable), so that the coloring of the exhibit palaces, the rich shades of the mural paintings, and the ornamental details of the buildings would appear at night in the same relative values as by day. It was early decided to abandon the method of outline or silhouette lighting employed at other expositions and to use at the Panama-Pacific International Exposition only reflected light as the principal source of the illumination. The objection to outline lighting was two-fold: the great strings of electric lights formerly used to outline the contours of the exposition palaces cast black shadows, so that only a portion of the exposition was seen. Moreover, the dark shadows frequently obliterated the very features which the sculptor intended most to emphasize. The sculptor demands that his work shall not be impaired by the method of illumination, and this demand, too, is true of the architect and of the artist.

In the illumination of the Panama-Pacific International Exposition it was felt that the recent advances in illumination methods and materials had rendered practical a plan of illumination that would have been impossible at the last great exposition, at St. Louis, ten years ago. Moreover, the operation of batteries of searchlight projectors had developed to such an extent as to produce amazing pyrotechnic effects in variety, intensity and splendor exceeding and overwhelming any results achieved through the use of fireworks.

At the exposition the lighting is produced with a dramatic effect suggesting undreamed of power and potentiality. A resplendent aurora of colored light spreads far into the heavens from a giant scintillator placed on the harbor's edge before the exhibit palaces and it is visible at a distance of from fifty to sixty miles.

Great shafts of light, quivering and changing, reach far into the heavens like tentacles of giant octopi. Numerous unexpected results are produced. Through the intersection of one shaft of light with another, for example, great rings suggesting those blown from a cigar are made to appear in the heavens.

Four principal methods of illumination are employed at San Francisco. Opposite the walls of the exhibit palaces are luminous art standards bearing heraldic shields which reflect light against the façades of the palaces. The shields are transparent, the sides nearest the palaces presenting a white surface which reflects the light against the buildings. The side of the shields farthest from the palaces is faced with a heraldic emblem on which is written the early history of the Pacific Ocean and of California and through which the light shines.

The second method of indirect illumination is found in the concealed batteries of searchlight projectors mounted upon the exhibit palaces and at other points of vantage. While the projectors themselves are not visible, their light directed against the monumental sculptures, towers and minarets, imbues these objects with radiancy. All of the principal architectural and sculptural works of the exposition stand out at night like giant transparencies, and even their minor details are clearly outlined.

The third source of lighting—although the order in which the sources are enumerated is purely one of convenience—is that of the concealed light which proceeds from the inner recesses of the columns which encircle the courts or are placed upon the lofty Tower of Jewels and on the two Italian towers, commanding the entrance to the Court of Palms and to the Court of Flowers. This method of lighting is also used in the vaults of the great archways and in other situations where it is desired to cast light upon the mural paintings. From afar one sees the Tower of Jewels radiant under the shafts of light case by the giant searchlights and a phosphorescent tinge as if the tower were itself a source of light is imparted through the rich Venetian glow of the lights placed inside the columns on the tower and not visible to the spectator. Thus, one beholding the tower, sees it limned against the heavens by the batteries of white searchlights, while the concealed lights on the inner recesses of its columns, suggesting a charcoal furnace, imbue the tower with the effect of transparency.

The visitor beholds this monument quivering with thousands of shaking prisms and seeming itself to emit light as though it were some giant pyramid of celluloid through whose transparent surface the red glow from within is revealed. The fourth source of light is that

(Concluded on page 389.)

# Valuable Products Recovered from Coke Oven Gases

## The Enormous By-product Coke Plant at Gary, Indiana

ENOUGH benzol to run 200,000 automobiles per year, and enough sulphate of ammonia to supply the farmers of this country with fertilizer for two years, at the present rate of consumption, was thrown away in the waste gases of the bee-hive coke ovens of the United States, in 1912. In addition to this, large quantities of tar, and even of the coke itself, were consumed by the extravagant process of the bee-hive oven. All together the value of the by-products had they been recovered would have been about $80,000,000. If the same amount of coal had been coked in retort ovens, over five million more tons of coke would have been obtained. It is estimated that about 6,800,000 tons of coal were absolutely destroyed.

Only in a land rich in natural resources is such prodigality tolerated. In Germany, where coal is mined at great depths under conditions that make the product more expensive, bee-hive ovens were abolished twenty years ago. All coke is produced in retort ovens, and in 1911, 80 per cent of these retort ovens were of the by-product recovery type. In the bee-hive type of oven a certain amount of air is admitted into the oven, which results in consuming not only the free gases of the coal, but also some of the coal itself; while in the retort type of oven no air is admitted, and consequently there is very little loss of fixed carbon, such loss as occurs being due to the presence of air in the oven when it is charged, and also the exposure of the incandescent coke to the air when it is discharged from the oven and before it is quenched.

We are now beginning to realize how wasteful is the bee-hive oven and how necessary it is for us to conserve our supplies of fuel. In 1911 about twenty-seven million tons were made in bee-hive ovens as against nearly eight million tons in by-product ovens. In 1912 eleven million tons of coke were produced by means of the by-product system, and in 1913 by-product coke amounted to 12.7 million tons. The figures for last year's output of by-product coke and the ratio to bee-hive coke have not yet been compiled. When plants now building are completed, nearly half of the coke made in Southern States will be produced in by-product ovens. Bee-hive plants are usually located near the mines, while by-product plants are located usually at the point where the coke is used. In illustration of a typical by-product plant we publish herewith several photographs taken at the enormous coke plant of the United States Steel Corporation, at Gary, Ind. It is the largest by-product coke plant in the world, comprising 560 ovens. Here, 2,900,000 tons of coke are produced per year, all of which is used in the adjoining steel plant. A hundred and twenty million cubic feet of gas are recovered per twenty-four hours, which is much more than all the gas consumed in the city of Chicago. Half of the gas is used for heating the ovens, while the other half is used in the heating furnaces as well as in the open hearth furnaces of the steel plant. The ovens are arranged in two rows of four batteries each, and there are seventy ovens to a battery. The ovens are 32 feet long, and taper from a width of 17 inches at one end to 21 inches at the other, the purpose of this taper being to facilitate the discharge of the coke.

Briefly, the coking process is as follows: The coal is screened and then crushed until 90 per cent of it passes through a screen of ⅛-inch mesh. After this it is carried up to a mixer where the coals are combined in the proper proportions. Thence it goes to the storage bins. From the storage bins the finely crushed coal is carried in lorry cars which run on tracks over the ovens. The coal is dumped out of the car into the oven through charging holes at the top and is leveled off. Then the charging holes are sealed, and the coal is coked for from seventeen to twenty hours.

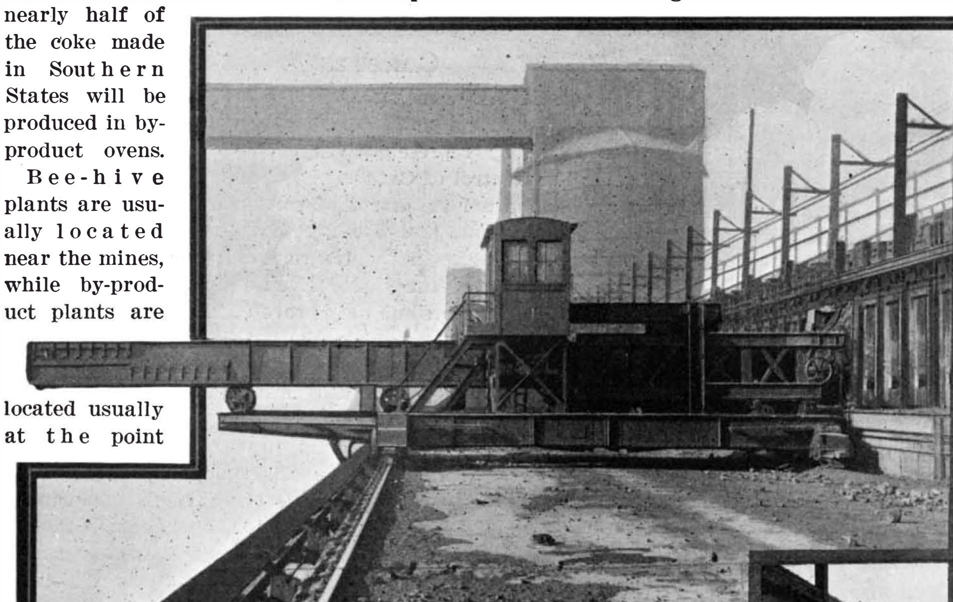
A longitudinal section of an oven chamber is shown in an accompanying drawing, which illustrates the regenerator, for utilizing the heat in the gases. Gas from the by-product plant comes through the mains *A*, running along the entire length of the battery of ovens at each side, and then passes through the riser pipe *B*, into gas distributing channels *C* of fire brick under the ovens. From the gas distributing channels, the gas enters passages *D*, between the ovens, where on coming in contact with heated air, it is ignited. The air enters the combustion chamber from the passageway *E*; then it goes through one of the two regenerators *F*, of checker brick, where it is heated to from 2,000 to 2,200 deg. Fahr. The burning gases flow up the flues *D* on one half of the length of the ovens and the products of combustion pass down the heating flues on the other half of the regenerator on that side, whence they are sucked out through the flues *G*, connecting with the chimney. The checker bricks in this second half of the regenerator extract the heat from the burnt gases and store it up. When the course of the gases is reversed fresh air passes through this second half of the regenerator and its temperature is raised by the heat stored therein, while the burnt gases now flow through and deliver heat to the first half of the regenerator. Every half hour, on the average, the course of the gases is reversed.

After about eighteen hours, when the coal has been thoroughly coked, a pushing machine moves to position at one end of the oven while a car, to receive the coke, is brought into place at the opposite end. Guides are placed each side of the discharge ends of the oven, and the doors are removed at each end of the oven by mechanical means. The ram, or pusher, then is brought into operation.

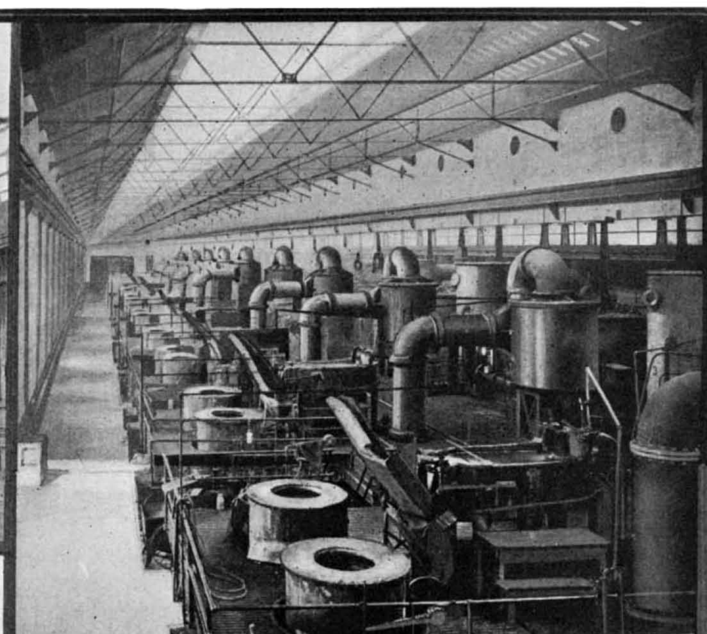
This consists of a long beam with a pusher head just fitting the doorway of the oven. This ram is operated to push the coke out of the oven and into the coke car. One of our photographs shows the pusher in operation, while immediately below may be seen the glowing coke forced out of the oven between the guides and tumbling into the car. As soon as an oven is discharged, the glowing coke is carried to a quencher where a shower of water drowns out the blaze, and cools the coke to a point where there is no further loss by combustion. As soon as the oven is discharged, the doors are replaced and sealed with fire clay and a fresh charge of coal is dumped into it.

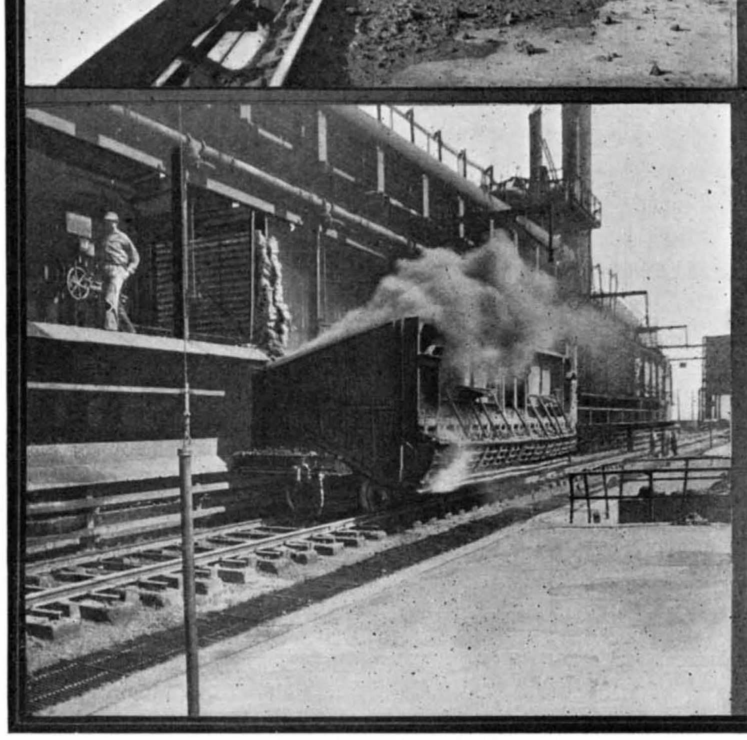
It should be understood, of course, that this is by no means the only successful type of coke oven. We have chosen it for illustration because the largest plant is of this type. But no article on by-product coke would be complete without a description of the horizontal flue type of oven. As shown in section in one of our drawings, each oven is provided with two regenerators. The air is blown in by a fan

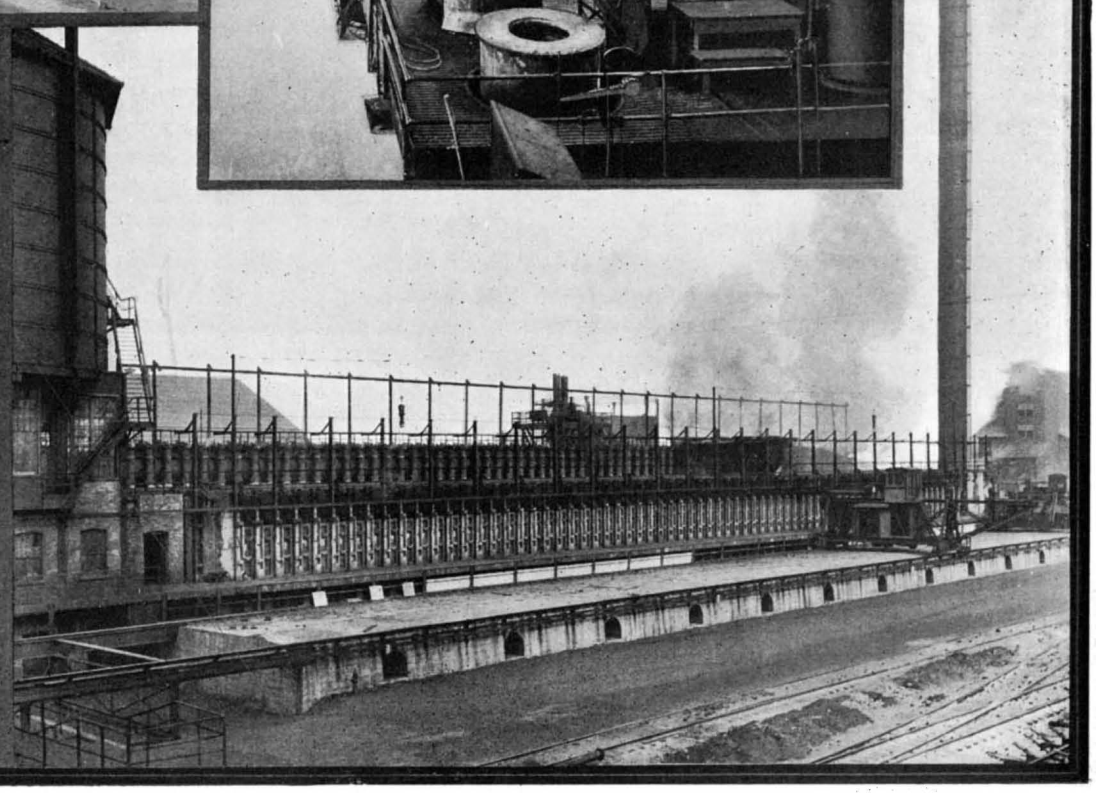
The pusher about to discharge an oven.



Acid separators recovering ammonium sulphate from the gas.







Flaming coke tumbling out of an oven into the car.

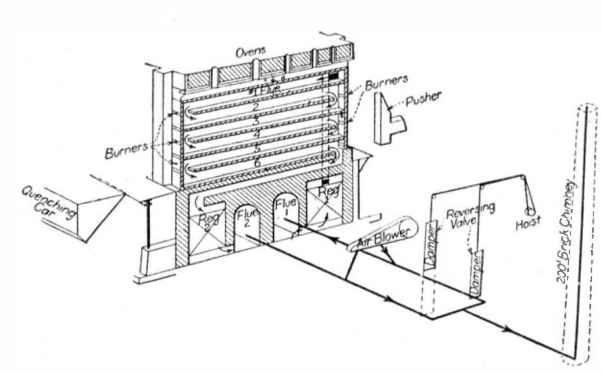
A battery of seventy coke ovens viewed from the pusher side.

through one of the regenerators and passes up through the flue system burning the gas which is supplied to each flue. The products of combustion pass out through the other generator. On turning a damper the flow for an entire battery of ovens is reversed, the air now flowing in, from the second regenerator, to the top and descending through the horizontal combustion flues.

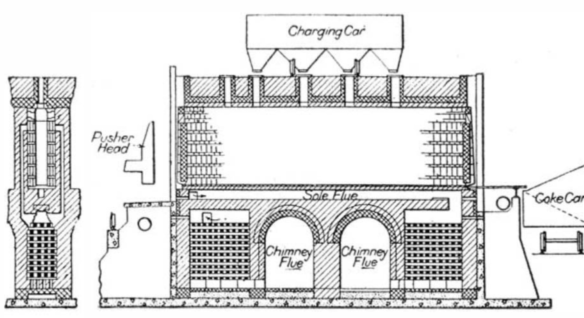
Returning to the plant at Gary, the gases on leaving the oven pass on to the by-product plant, where they are first cooled with air and water from a temperature of 1,000 degrees to about 104 deg. Fahr. This results in precipitating most of the tar and ammonia. Thence the gas passes through a pre-heater, which raises its temperature to about 160 deg. Fahr., and is conducted to an acid saturator, in which the ammonia is extracted by contact with sulphuric acid and is recovered in the form of ammonium sulphate. The salt is removed from the saturator by means of an air ejector and is delivered upon a collecting table, whence it is run off with the mother liquor into a centrifugal dryer. From the saturator the gas passes through the acid separator and then returns through the mains to the oven. The tar recovered by this process is used to a small extent for fuel purposes in the steel plant, but most of it is sold for use in the manufacture of saturated felts and pitch for roofing, waterproofing and paving, and also for road construction, the extraction of tar products, etc. The ammonia liquor recovered by this process, after refining, is used largely for refrigerating purposes in the slaughter houses of Chicago, while the sulphate of ammonia is sold for use as a fertilizer, for which purpose it is in great demand. As it contains 20.5 per cent nitrogen, which is by far the most costly element of plant food, and the one of which most soils are in need, this by-product is of great importance to our agriculture. It is regarded as a standard carrier of nitrogen both in this country and abroad, and is applied by itself or as an ingredient of commercial fertilizer mixtures. It is also interesting to learn that the nitrogen which was stored up by the sunshine and vegetation of the remote coal ages, and buried for uncounted centuries, now returns to the cycle of life and growth to feed the crops of our latter-day earth.

At present the plant at Gary is not equipped with apparatus for recovering benzol. A number of by-product plants already have such apparatus, and it is proposed to install benzol-recovering apparatus at all the largest and newest by-product coke oven plants.

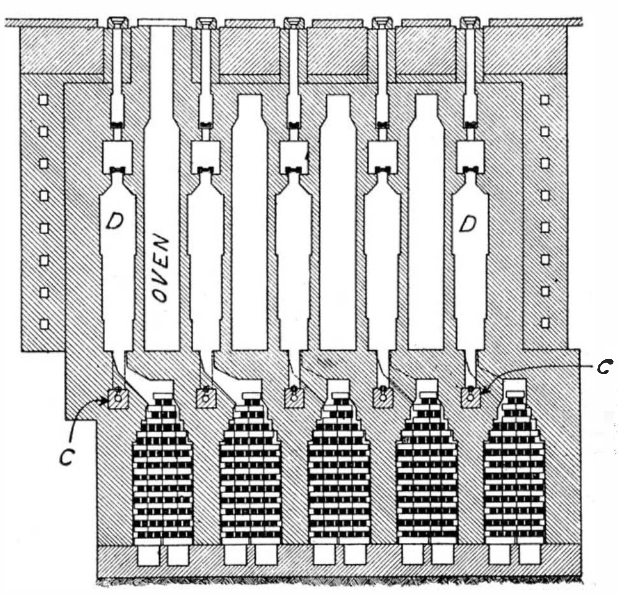
Contrary to the popular impression, benzol is not obtained from the tar, but from the coke oven gas. After the ammonia has been extracted the gas is scrubbed with a light oil which extracts the crude benzol. Then the benzol is obtained by distilling the oil in steam-heated stills. The oil may be used repeatedly.



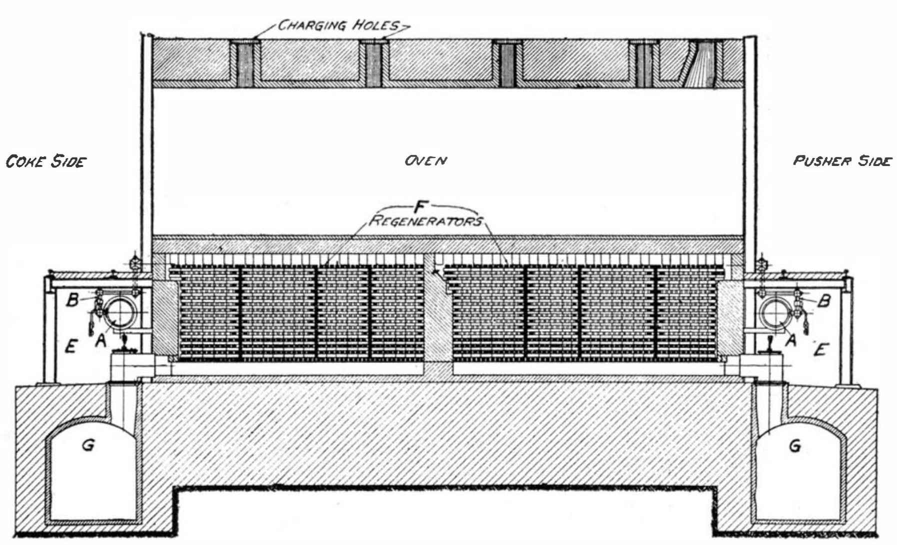

Method of controlling the heat in the horizontal flue oven.



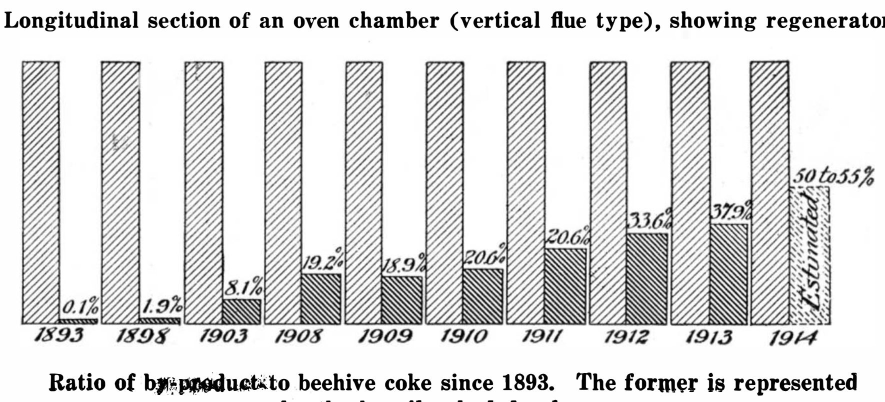

Horizontal flue type of coke oven.




Cross-section, showing the regenerators and the vertical heating flues at each side of the oven.




Longitudinal section of an oven chamber (vertical flue type), showing regenerators.




Ratio of by-product to beehive coke since 1893. The former is represented by the heavily shaded columns.

## The Barometer and Health

EVERY person capable of putting two and two together and obtaining the correct answer has been conscious of feeling out of sorts, as the printer would say, when the clouds hung low and the sun was obscured. A week of dull weather sets a whole community on edge and the mental, moral, and physical components of man are, at its close, about fit for the scrap heap. Under such atmospheric conditions, when prolonged for a number of days, an Englishman admits that he feels "seedy" and the American confesses that he is feeling "mean," both adjectives relating to a state of mental and bodily dumps.

This situation is generally attributed to the lack of sunshine, for every human being retains the ancient beliefs in the potentiality of the sun in its relation to his life and its well-being. He knows that it gives warmth and light and brings forth his crops from the fruitful earth, and rightly yields it a respect for its great and generally benign influence over mundane existence. It is true that we feel "bully" in sunshiny weather, but sunshine is the accompaniment of certain atmospheric conditions not wholly shown by the thermometer or the solarimeter. A few sunless days or hours are not sufficient, however, to put a "hoo-doo" on the temperament and activities of a whole population; there is another important controlling agency, but little understood, even if appreciated, and it exercises a much greater influence than the sun in a given space of time. If the sunlight were absolutely necessary to our upkeep night watchmen and laborers on the morning editions would be chronic invalids, and mine workers the most unhealthy people in existence. If sunlight were necessary to animal life all of the night prowlers would cease to exist.

The gaseous envelope of atmospheric air surrounding the earth is the medium in which we have to live, and it bears the same relation to the human family as the waters of the globe to the order of fishes. The air and water are essential to life, as much a factor to man as the quality of water to the fish. This normal atmospheric air exerts on our bodies a definite dynamic force or physical pressure of 14.7 pounds on every square inch of our bodies, if we live at or near the sea level, and the higher up we go this atmospheric pressure diminishes until on the heights of the Rockies it is probably two pounds less. The normal pressure at sea level is indicated by the barometer as 30 (inches), and it decreases by an established scale as it ascends these mountain heights. Most persons know that ascents of mountainous peaks, thousands of feet above sea level, result in marked physical distress, difficult breathing, general depression at the summits, and in extreme cases bleeding at the nose and even from the lungs, due to this lessened atmospheric pressure. Just so it happens that when the barometer is "low" for a considerable period, say a drop from 30, the normal gage, to 29 or below, when stormy or dull weather ensues, we get the analogous effect imperceptibly, but in an appreciable degree; for it has happened that a definite measure of atmospheric pressure is released from our bodies and naturally there follows a dislocation of our normal balance. The average adult man sustains on every pleasant day an atmospheric pressure of about 14 tons at sea level, when the barometer reads at 30 and a drop of an inch or more, to 29 and below, practically takes off half a ton or more of his load to which he is accustomed. Paradoxically, instead of feeling lighter and freer, man feels its disturbing depressing effect on his tissues. He has to become adjusted to this alteration from normal tensity to one of unusual relaxation, and while it is slow in its manifestations, as barometric changes are generally gradual, yet the effect in miniature is like going up to a great height on a mountain range. Of course this feeling is neither serious nor fatal, but the relaxed condition in unpleasant weather extending over a number of days makes us feel "out of sorts." While the spell is on we are in the doldrums and the situation is recognized as of enough importance by careful surgeons, who weigh every factor, to defer important operations which can be postponed, when these unfavorable barometric conditions prevail, and the patient needs every ounce of vitality to pull through.

It is just as well to know these fundamental facts about the influences which affect our physical being so that we can estimate that "tired" or "good-for-nothing" feeling which accompanies a spell of dull weather; to know that it has a definite and transitory cause outside our bodies. It is really an explanation of the ups and downs of our healthy existence. Naturally there is no remedy to be prescribed. As Mark Twain said about the weather—we talk a lot about it, but we never do anything to improve it.

## Cancer and Radium

A TIMELY warning against blind faith in the cure of cancer by radium was addressed to the public recently by representatives of the American Society for the Control of Cancer.

The radium treatment of cancer is as yet a matter of experiment, and the successful results have been obtained chiefly in the treatment of external cancers, particularly of the skin. Even granting that in the course of time radium may prove of much greater value than has been the case in the past, it was pointed out that a sufficient quantity of radium and the required experience in its use will not be available for some years, and in the meantime it is practically certain that large numbers of people are likely to be deluded by false hopes. The first principle in cancer treatment is the extreme danger of delay; and thus far a thoroughly qualified operation seems to hold out the only hope for a cure.

According to the opinion expressed by these speakers radium has probably been shown to exert a definitely curative effect on certain of the moderately malignant and superficial cancers of the skin, mouth and other readily accessible mucous membranes, provided that it is applied while the disease is still local and in the early stages.

Radium definitely relieves suffering when used in the advanced stages of deeper-seated cancers; but in those cases it improves only the visible or tangible manifestations and exerts no effect upon the disseminated disease as a whole. It is believed that there is as yet no proof that radium has finally cured any one case of advanced and disseminated cancer.

## The Mechanism of the Player Piano

IN the manufacture of actions for player-pianos there are 20,000 operations from the raw material to the finished product and a total of 4,063 individual parts enters into the making of each action.

# Correspondence

*[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]*

## Compulsory Licenses

To the Editor of the SCIENTIFIC AMERICAN:

I would like to call your attention to some defects in the argument of Commissioner of Patents Ewing against the introduction of the compulsory license and compulsory working of patents in this country, which is found in your issue of March 13th.

The Commissioner says: "The difficulties are economic. They are very acute in Great Britain in spite of provisions of her patent system which we are urged to adopt."

The British working clause of 1907 caused an immediate development of manufacturing which had previously been conducted in foreign countries. Not long after the law was passed, a decision by Judge Parker placing the burden of proof on the petitioner for revocation practically nullified the working clause. Advocates of a working clause are not urging the adoption of the provisions of the British patent system. They are advocating the adoption of an effective working clause in the United States law which will put an end to the present humiliating conditions under which the United States law is now used by foreigners to suppress industries in the United States and develop them in foreign countries.

Moreover, the British Act can no longer be considered ineffective, for on February 22nd the president of the British Board of Trade, Mr. Runciman, made this statement in the House of Commons showing that the British working clause will work in the future:

"The success of the (dyestuff) concern must depend largely upon the way in which German patents are administered, and it is the intention of the government not to cripple the company after the war was over, but to give them every opportunity of making the most of the German patents."

Commissioner Ewing's reference to treaties with foreign nations gives the impression that something terrible would follow the enactment of a working clause in our law to correspond with the working clause that Germany has enforced for over forty years and which England intends to enforce and would have enforced eight years ago but for a technicality in the interpretation of her statute. If our patent treaties are of that one-sided character, they are evidently in need of change. The Commissioner, without giving its terms, refers to the Bernstorff-Bacon patent treaty of 1909 as if it were advantageous to the United States. That treaty was negotiated in secret immediately after and evidently because of the agitation for a working clause that started in this country in 1907. The public knows very little about this Bernstorff-Bacon treaty. Instead of being to the advantage of the United States it is very much to the advantage of Germany, as will be clearly seen from the following provision:

"The working of a patent, working pattern (Gebrauchsmuster), design, or model in the territory of one of the contracting parties shall be considered as equivalent to its working in the territory of the other party."

For forty years the United States protected and developed the German dyestuff monopoly by giving German owners of patents an unqualified patent protection in this country, while during the same period Germany developed her industries by an effective working clause. But when Congress proposed in 1908 to enact a working clause for the development of American industry the Bernstorff-Bacon treaty was negotiated to nullify the effect of any working clause Congress might enact by providing that working an invention in Germany shall be equivalent to working it in the United States. This may have been a triumph of diplomacy, but in view of the relative development of manufacturing based on patents in the United States and Germany it cannot be called a triumph of American diplomacy.

The European war has disclosed the industrial dependence of the United States on foreign countries. The most striking illustration of this dependence is found in textile manufacturing, an industry giving employment to over 1,000,000 people and producing annually over $2,000,000,000 worth of goods, and whose existence is mainly dependent on the importation of $10,000,000 worth of dyestuffs from Germany. This perilous situation has existed for years and has been known to everyone acquainted with conditions in the textile industry. The only difference now is that the European war has stopped the German supply of dyestuffs and aroused the entire country to the humiliating position occupied by a country accustomed to boasting of its independence.

The problem involves other factors besides a working clause. A protective tariff will be required for the establishment of a dyestuff industry in the United States. There will have to be co-operation between science and industry, such as exists now in Germany. If the United States is to develop this industry, we must employ all the methods that Germany has found useful, and among these is an effective working clause in the patent law. Those who are experienced in the administering of patent law can render a valuable service to the public by pointing out how such a law should be framed so as to be effective without creating any difficulties to offset the advantages.

SAMUEL S. DALE.

Boston, Mass.

[So far as our correspondent's contentions relate to the coal tar chemical and dye industry, we would refer him to the paper by Dr. Bernhard C. Hesse on the "Contribution of the Chemist to the Industrial Development of the United States," read before the fiftieth meeting of the American Chemical Society at New Orleans. We cannot do better than quote the following from that excellent consideration of the subject:

"France, in the early days of the coal tar dye industry, was an important factor in the invention and in the manufacture of dyes; the same with Great Britain. France has always had a drastic working clause; in 1907 the British working clause was brought about at the insistent agitation of dyestuff makers of Great Britain, and they promised, in effect, to the British public, that if that working clause were enacted into statute, an independent British coal tar dye industry would spring up at once. After the law had been in operation six years and a half and Great Britain could no longer deal with Germany, what was the result? Was Great Britain able to supply its own needs of coal tar dyes? Certainly not. Was France? Certainly not. Now, since neither of these countries was able to supply its dyestuff needs, when it could no longer trade with Germany, was the working clause the cause of that condition? If not, what was? Certainly the working clause did not prevent that condition from arising. If the British working clause, the last, and presumably the best of the fifty-six measures now in force attempted compulsory working, absolutely and utterly failed to produce in six and one half years a coal tar dye industry, when it had at that time five coal tar dye factories of its own—each of them at one time or another making some of their own intermediate products and some of them at times even exporting to Germany—if those five British dye works *plus* the new British working clause could not produce the six million dollars' worth of dyes a year that Great Britain imported in 1912, and make themselves independent of Germany, on what grounds and by what course of reasoning has anybody the right to assume that if we were to put the British working clause bodily on our statute books, we would create a large coal tar dye industry, at once or within *any reasonable* time? . . .

"At the meeting of the Imperial Industries Club of Great Britain, April 1st, 1914, the compulsory working of patents was discussed. No one speaking in favor of the 1907 British Act named any specific cases of any new industries being brought to Great Britain thereby. Those speaking against the Act referred to case after case where foreigners revoked the British patents and then dumped foreign-made goods on the British market. Lord Moulton said of this British Act: 'It is no use arguing about legislation of that kind. It is self-condemned.'

"Those who have spoken favorably of this British Act with but one or two exceptions have colored their statements; for example, one new plant was represented as employing 1,600 people—it employed only 37; another represented at 600 employees, employed 60. There are no official figures as to the real effect of this Act; the only figures are those of real estate agents having land and factories for sale; under these circumstances their fall from truth is understandable, but it does not make it their credibility. . . .

"Furthermore, it must be remembered that on July 13th, 1832, the President of the United States approved an act compelling all foreigners to work their patents in the United States under penalty of automatic cancellation. That act was repealed July 4th, 1836; it died at the tender age of three years, eleven months, and twenty-two days. If it was bad policy for us then, and experience proved it to be, why should it be good policy for us in 1915 to try the same thing over again? It has not worked in any of the fifty-six countries that have tried it. Why should it be successful after so many failures under present conditions and why should it be successful when the old conditions, under which it invariably failed, return?"

The whole tone of our correspondent's letter implies that patents are the basis of the dyestuff industry, and that since Germans own the patents Americans are helpless. According to Dr. Hesse, whom we quoted in our issue of September 26th, 1914, on this subject, out of a total of 912 coal tar dyes, 467 have never been patented in the United States, and the patents on 239 further dyestuffs have expired. Only 215 of these dyes are at present protected by patents. Of those dyes which we are at liberty to manufacture only about 10 per cent are actually made here, and these very largely from imported coal tar products not themselves dyes.

Our correspondent is wrong in supposing that Germany has a very drastic working clause. As a matter of fact, Germany's working clause is so liberally construed that the most perfunctory compliance with its terms is accepted. Indeed, Germany retains her working clause not because she believes in it, but simply because she can use it as an effective weapon against those countries which threaten to hamper foreigners by injecting into their patent system revocation and compulsory license clauses.

The Bernstorff-Bacon Treaty, which our correspondent regards as decidedly anti-American in its effect, is in reality a boon to American manufacturers. German courts have interpreted the treaty so liberally that, as a matter of fact, America stands in a better relation to the German patent system than Germans themselves. The experience of the National Cash Register Company is a case in point. Patents owned by that company had been assigned to a German; they had never been worked even in the perfunctory fashion required by the law. A petition was made by a German firm for the revocation of the patents. The court held that even though they had been assigned to a German and were in effect outside of the treaty, nevertheless it considered it necessary to place them outside of the provisions of the working clause. In other words, the invention was American, and because it had been originally patented by an American in Germany, the court refused to apply the German working clause to it. If this is the manner in which the Bernstorff-Bacon Treaty works, we would dislike to see it repealed.

We are in accord with our correspondent when he states that there must be co-operation between science and industry as exists now in Germany. There must also be co-operation between government and industry. What we want is more encouragement and less opposition from our legislators.—EDITOR.]

## The Death of Cecil Peoli

It is with great regret that we have to record the death of Cecil M. Peoli from a fall of about one hundred feet in a new machine with which he was experimenting for the U. S. Navy. This aeroplane, which had a spread of 48 feet and was fitted with a 140 horsepower 12-cylinder V-type motor, appeared to be tail-heavy on its trial flight at the Aviation Field at College Park, Md., with the result that it crashed to the ground soon after young Peoli had arisen and while he was flying at a height of 75 to 100 feet. The aviator, who was but twenty-one years old, was crushed beneath the motor and killed instantly. Cecil Peoli was one of the leading American boys to make and fly model aeroplanes. His record-breaking model was described by himself in the SCIENTIFIC AMERICAN a few years ago. He afterward became an aviator under the tutelage of Capt. Thomas A. Baldwin and flew the latter's machine for a couple of years. In 1913 he made a trip to South America, where he flew over the Andes, and, on one occasion, had a very close shave from crashing into a peak of one of these mountains while flying in a fog. He managed to swerve sharply just in time and to descend safely to the coast from which he started. It is indeed the irony of fate that so young a life should be snuffed out as a result of a slight fall when the aviator had been through such dangerous experiences. While his machine was intended for the Navy, Peoli was experimenting above land, as he had never flown an hydroaeroplane. Had he experimented over the water, in all probability he would not have been killed. This is another proof that no matter how expert the flier, he will do well to experiment over water rather than over land.

## Prof. C. W. MacCord Dead

CHARLES WILLIAM MacCORD, professor emeritus of Stevens Institute and noted as a leading authority on all matters relating to mechanical drawing, died recently at his residence in Hoboken, N. J., at the age of 86 years. He was born in Dutchess County, N. Y., and graduated from Princeton University with the degree of A. B., later taking the Masters degree, and in 1881 receiving the degree of Sc.D.

For many years he was employed as a draughtsman by Capt. John Ericsson, during which time he drew the plans for the "Monitor," the original turreted war vessel that defeated the Confederate iron-clad "Merrimac." In 1871 he became professor of mechanical drawing and designing at the Stevens Institute, and held this chair until his retirement in 1906. Prof. MacCord was at one time a frequent contributor to the SCIENTIFIC AMERICAN, and was the author of a number of works on mathematics, geometry, and draughting.

## Protecting the Eyes of Railroad Employees

WITH the object of protecting its employees against permanent injury to the eye or loss of sight, the Baltimore & Ohio Railroad Company, in a circular just issued, urges that in all cases of injury or of the lodgment of foreign particles in the eye, the employee at once seek the services of a company physician, whenever this be possible, rather than attempt to treat the injury or allow fellow employees to do so. Railroad experience cites many instances of permanent injury to the eye or total loss of sight sustained as the result of attempts by inexperienced persons to usurp the office of surgeon. The immediate securing of medical attention, it is held, eliminates the possibility of infection.

## To Old Readers of the Scientific American

THE June number of the SCIENTIFIC AMERICAN will commemorate the seventieth anniversary of the house of Munn & Co. In that number we wish to give a history of the SCIENTIFIC AMERICAN. Old readers and subscribers who visited the editorial offices in the past are requested to send us their impressions, anecdotes, experiences, and the like. Indeed, any information at all relating to the old offices on Park Row will be gratefully received by the Editors.

# Saving Eight Million Tons of Coal a Year

## A Hydro-Electric Development That Uses a Head of 4,000 Feet

FED by the snow caps of the Sierra Nevadas about seventy miles east of Fresno, Cal., is a stream that flows with much fuss and bluster down the mountain sides to the San Joaquin River. Locally this stream is known as "Big Creek." But despite its ambitious name, one may search in vain for a trace of it in the common atlas. Now, however, its ambitions are about to be realized, for in one respect at least it is to surpass the mightiest river of the continent. A Government permit was recently granted to a light and power company to extract from this mountain stream 350,000 horse-power—more than will be obtained from the great Mississippi River when the hydro-electric development at Keokuk is carried to completion!

This astonishing disparity of size and power disappears when we learn that above Keokuk the Mississippi has a fall of but 23 feet in twelve miles, while Big Creek in half that distance drops 4,000 feet. And a copious amount of water pours down the precipitous course; for Big Creek drains a basin of about 88 square miles, which with an annual rainfall of more than 80 inches gives a run-off of about 50 inches. This basin, 7,000 feet above the sea, forms a natural trap for the moisture-laden winds from the Pacific. On the south and west it is bounded by comparatively low ridges, but on the east the peaks of the Kaiser range rise to elevations of 10,000 and 11,000 feet, and so the moisture sucked up from the Pacific is carried by the wind over the southern and western ridges, only to be precipitated against the cold peaks of the north and east. With plenty of water thus assured and an enormous head, conditions are ideal for the generation of electricity.

California is famed for its enormous hydro-electric achievements, but in the work already done we have something to astonish even the Pacific coast. Here is by far the largest high head development in this country. It employs the most powerful impulse wheels ever built and the largest electric generators of their type. The current is transmitted over the longest "express" line in existence, at the highest voltage ever used commercially.

The permit acquired by the Pacific Light and Power Corporation of Los Angeles to develop the power of Big Creek allowed twelve years for the completion of the work. But with great enterprise the company set a record for rapid work in completing the initial development inside of two years. The first work was to build a railroad 56 miles long to reach the site of the development. This road was finished and equipped in 157 days. Then three concrete dams were constructed to close gaps between the ridges bounding the basin in the mountains, thus making the reservoir 7,000 feet above the sea, four and one half miles long by half a mile wide, with a capacity of about 53,000 acre-feet. The capacity will later be increased to 120,000 acre-feet by raising the dams 50 feet higher.

The fall of 4,000 feet has been utilized by leading the water through a tunnel and steel pipe lines to the first power house half way down, and then through another tunnel and series of conduits to the second power house. Some conception of the enormous drop from the basin to the first power house may be gathered from the accompanying photograph in which the three tallest buildings in New York have been drawn to serve as a scale. If on top of the Woolworth Building were placed the Singer Building and on top of that the Metropolitan Tower, their combined height would just about equal that of the reservoir above the first power house. Driven by this mighty head, the water rushes out of the 6-inch nozzles at the power house with a velocity of 350 feet per second, which is about 240 miles per hour. The jets dash across an open space of a few inches and then strike the buckets of the impulse wheels, which spin around as fast as the drivers of an express locomotive traveling 100 miles per hour. These wheels are 94 inches in diameter and are arranged in pairs, each pair developing 23,500 horse-power. Despite the enormous velocity of the jet, there is no shock at the impact with the water wheel, because the part of the bucket first touched is nearly parallel with the jet.

After passing through the first power house the water discharges into the creek. But the creek is here blocked by dam No. 4 and the water is diverted through a second tunnel four miles long into a second series of steel conduits leading to the second power house.

In each power house there are two main generators of 17,500 kilowatts capacity each. Here the current is generated at 6,600 volts and raised by transformers to 150,000 volts. The current is carried to Los Angeles, 240 miles away. Two lines of steel towers on a right of way 150 feet wide will carry six cables an inch in diameter, from the two power stations to a substation at Eagle Rock, in the suburbs of Los Angeles.

In less than a year and a half after the work at Big Creek was begun both power stations and one transmission line were in operation and current generated at Big Creek was in commercial use at Los Angeles. This involved the setting of more than 3,000 steel towers over the mountains and across the desert and the stringing of nearly 5,000,000 pounds of aluminium cable. It is interesting to note that, by virtue of the great elevation of the reservoir above the two power plants, every cubic yard of water it contains is worth from ten to twenty pounds of coal, considering that it takes from four to eight pounds of coal to generate one horse-power in a steam plant. When the full possibilities of the Big Creek development are realized it will form an inexhaustible mine of energy with an output that could not be equaled by the consumption of over eight million tons of coal per year in a very efficient power plant. It represents that much saving of our limited and rapidly diminishing natural supplies of stored energy.

We are indebted to the Stone & Webster Construction Company, who were the constructing engineers, for the accompanying illustrations and details of this remarkable work.

### A New Searchlight for the United States Navy

**By Herbert T. Wade**

THE probability that battles will be fought largely at night and will begin at an extremely long range in the naval warfare of the future and the increased importance of torpedo and torpedo-boat attacks make the searchlight of the modern battleship an important weapon of offense and defense second only to the guns themselves. Accordingly, improvements are taking place in such apparatus, and the United States and other navies are trying out new devices to secure greater effectiveness.

Recently the United States Navy has secured a searchlight of somewhat novel form which already has found a considerable application in Europe, both for ships of war and for coast defenses. This searchlight, which is 44 inches in diameter and so far is the largest instrument of the kind yet installed in the United States Navy, has, instead of the usual silver, a gold mirror, which can be controlled automatically from a distant station by an observer at the telescope. With the installation of 14-inch guns and even larger weapons on recent battleships concussion is apt to prove disastrous to the mirrors and mechanism of searchlights of the older types, and it even has been rumored that in certain foreign navies these searchlights have been dismounted at the time of practice with the heavy guns.

The searchlight, it will be recalled, is a powerful electric arc lamp placed at the focus of a parabolic mirror, which is carefully shaped or figured so that it will project a beam of rays approximately parallel and in any desired direction, being capable of movement and control, so as to sweep the horizon and illuminate any object within its range of visibility. These mirrors, like those of the reflecting telescope of the astronomer, are usually made of glass with a film of silver deposited on the surface and then highly polished. The best reflectors for searchlights have been made in Europe, it being only recently that American manufacturers have taken up the making of such mirrors.

Obviously, the mirror of glass at best is delicate and is likely to crack from shock or concussion, while a silver surface is, in addition, liable to corrosion. When it is considered that searchlights with mirrors of more than six feet in diameter are required for purposes of coast defense, it will be seen how serious such a difficulty is; and when it is further considered that a chance hit by even the smallest projectile is likely to put the apparatus permanently out of service, the necessity for improvement in the design and construction of a searchlight may be appreciated.

The new mirror of the United States Navy Department, designed by J. A. Rey, in France, makes use of an important improvement by substituting gold for silver as the reflecting surface. This film of gold is electroplated in a parabolic surface formed from a massive casting of bronze, which is turned to the approximate shape and then is figured out as accurately as possible. Not only can such a mirror withstand the shock and concussion to a greater degree than one of glass, but even if the reflector itself is pierced by a bullet or small shell the apparatus may not be seriously damaged. But equally important are the improved optical properties which the gold surface affords. There is a marked increase in visibility, by which is not meant the greater photometric efficiency, but the projection of the rays toward the red end of the spectrum instead of greater amounts of the blue and the violet or shorter rays which are reflected out from a silver surface. As a result, the more mellow light of the gold mirror lights up the distant ship or other target at a distance with a soft illumination that shows detail and affords greater convenience in sighting to the gun-layer.

The advantages claimed for the gold mirror are rather in the direction of an efficiency and effectiveness as regards the special work in hand than securing a greater intensity of illumination. Thus, in the case of a fog or haze the gold beam is able to pass through the atmosphere containing water vapor, mist, or rain in fine drops more effectively than the beam from the silver reflectors.

The 44-inch searchlight, the largest yet to be tested for the United States Navy, has been tried last year on the battleship "Arkansas," and as a result of preliminary tests was acquired by the Navy Department. In addition to possessing a gilt mirror there is an interesting mechanism for distant control, which adds greatly to the effectiveness of the installation. The searchlight may be mounted at any desired point of the superstructure, where it may have a range of 180 degrees in a horizontal plane with sufficient vertical adjustment for all ordinary purposes. At the bridge or other convenient position for the observer there is a pedestal with a telescope.

The observer, with eye to the telescope and shoulder at the arm rest, moves the latter so as to keep his cross-wires focused on any desired object or target, and the corresponding motion is communicated to the searchlight, so that observer or gun crew may follow the motion of an approaching torpedo boat or other target. The control of the motion is effected through the familiar Wheatsone bridge principle and provides for the movement of the distant electric motors at the searchlight supplied with current from the ship's mains, so that motion is imparted to the searchlight corresponding to the motion of the telescope of the observer. Furthermore, the observer is able to control the illumination of the searchlight both by means of a shutter and by dimming the arc so that its full intensity need only be used when desired without undue expenditure of carbons or energy. The carbons employed are 20 millimeters in diameter in the case of the upper carbon and about 10 inches in diameter for the lower, the upper carbon being arranged horizontally so that its crater is always in the focus of the parabolic mirror. The system of control just outlined is also the invention of J. A. Rey and is covered by foreign and American letters patent. Similar installations have been used in the leading European navies and also for coast defenses and for portable searchlight battalions, which are an important feature of continental armies.

### Longitudes by Wireless Telegraphy

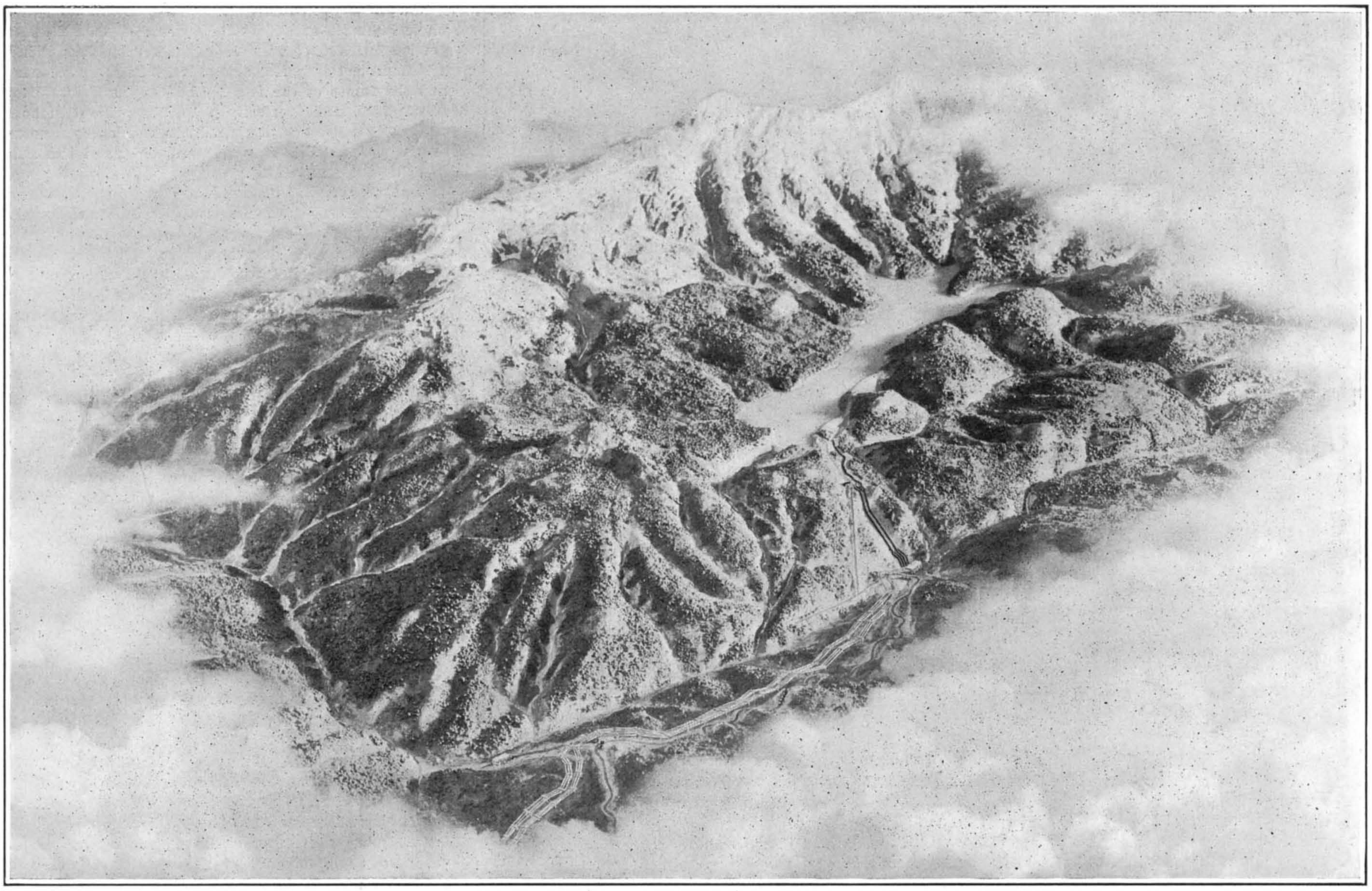
**By Prof. F. B. Littell, U. S. N.**

ONE of the important scientific uses to which wireless telegraphy can be put is the determination of differences of longitudes. For this purpose it is only necessary to make a signal at any wireless station and to have this signal received and the time noted at the points whose difference of longitude is to be determined. For the determination of the time with accuracy it is necessary to have recourse to astronomical observations. Where the highest accuracy is desired, it is necessary to make a correction for the time of transmission of the signal, but as wireless signals travel approximately with the speed of light, this correction is very small.

This method is particularly applicable to the determination of the longitudes of places not on telegraph lines, and this opens up a broad field for its future usefulness. The question as to whether it could be utilized for transatlantic longitudes has been answered in the affirmative by the successful work of the American and French parties in the winter of 1913-1914 in determining the difference of longitude between Washington and Paris, and it has been shown that for the connection of important places where high-power wireless stations are available, there is great advantage over the previously employed cable methods.

As in this case there was wireless transmission in both directions, the transmission time was also determined with a fair degree of precision. The time of transmission from Washington to Paris or *vice versa* is only one-fiftieth of a second, and it is evident that the work of the radio observers must have been very excellent to determine so small a quantity with a probable error of only 10 per cent of its value or one-five-hundredth of a second.

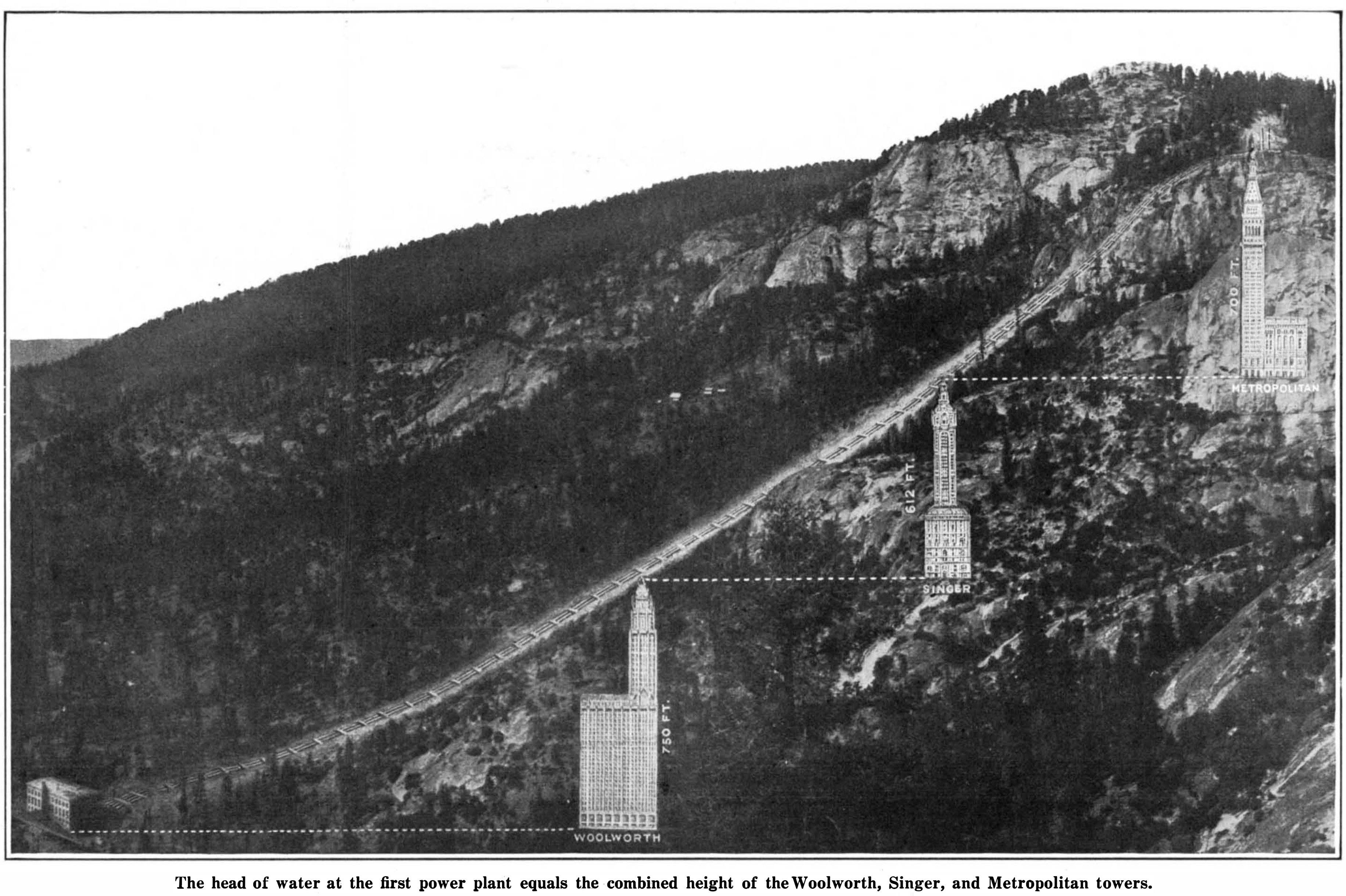
A full account reprinted from the *Astronomical Jour-*



**Bird's eye view of the Big Creek initial development, showing the two power plants and the transmission lines leading from them.**

*nal* of the work of the American observers will be found in the SCIENTIFIC AMERICAN SUPPLEMENT of the current issue. This marks the most notable advance in method since the introduction of the use of the submarine cable in 1866 by Dr. B. A. Gould of the U. S. Coast Survey. The proposition to make the determination originated with the Naval Observatory, but the technique of the method had already been developed by the French geodesists and astronomers, who have applied it extensively on land lines. The close agreement of the values obtained from this work with those obtained from the cable determinations furnishes an excellent tribute to the care and skill with which those determinations were made.

**Converting the Car Into a Sleeping Compartment.**—E. L. Thompson, of Glenns Ferry, Idaho, has secured patent No. 1,131,875 for an auto body in which the side portions of the front and rear seat are so supported and operated in connection with supplemental cushions that the vehicle may be readily converted into a full sleeping compartment or one in which a bed surface extends practically throughout the length of the auto body or a partial sleeping body in which the bed will extend from the back of the rear seat to the back of the front seat, the latter being intact so the driver can continue to operate the machine.




**The head of water at the first power plant equals the combined height of the Woolworth, Singer, and Metropolitan towers.**

## The Sound Wheel, a Novel Wireless Detector

**By the Berlin Correspondent of the Scientific American**

THE measuring of extremely small currents of a frequency of at least 30,000 per second, as used in wireless telegraphy, of course, affords enormous difficulties. Whereas direct-current galvanometers, capable of gaging currents of, say, $10^{-8}$ ampere, are readily obtained by providing a sufficiently strong magnetic field, it is quite impossible to do the same in the case of alternating currents, unless the magnetic field be excited by an alternating current of exactly the same frequency, which is obviously quite impossible.

Dr. R. Goldschmidt, the inventor of a wave generator, has had a fortunate idea in utilizing to this end the principle embodied in the Leblanc commutator machine, which, as is well known, mainly consists of a rotating commutator. The segments of this machine derive their tension from the terminals of a transformer, the conversion of alternate into direct current being effected by simple commutation.

In order to insure a sufficient rate of commutation, Dr. Goldschmidt, however, simplified this apparatus by substituting for the commutator a toothed disk which, so far from reversing the current, only breaks it once in every wave. If the currents to be gaged have a frequency of, say, 40,000 cycles per second, and if each tooth of the wheel is 1 millimeter in width, there will be a synchronous rotation for a peripheric speed of $40{,}000 \times 1$ millimeter $= 40$ meter-seconds; that is, for a perfectly practicable speed. On account, however, of the impossibility of a strictly synchronous rotation, Dr. Goldschmidt arranges the wheel to rotate intentionally at a synchronous speed, choosing, e. g., for 40,000 cycles, a frequency of interruption of 39,000 or 41,000. The transformed current then takes the form of an alternate current of the frequency $40{,}000 - 39{,}000 = 1{,}000$. The number of turns of the wheel need not, however, approach the synchronous speed; generally speaking, any odd fraction of this speed will be found sufficient. If an alternating current of given frequency be applied to the "sound" wheel, as the apparatus is termed, the wheel passing slowly from its state of rest to the normal number of turns, the sound will pass through the whole scale, and a continual singing will be heard in the telephone receiver until about one-third of the normal number of turns is reached. An interval then occurs which lasts until close to the speed of synchronism. If the contact brush be of sufficient width, the same sound phenomena will also take place with even fractions of the synchronous speed.

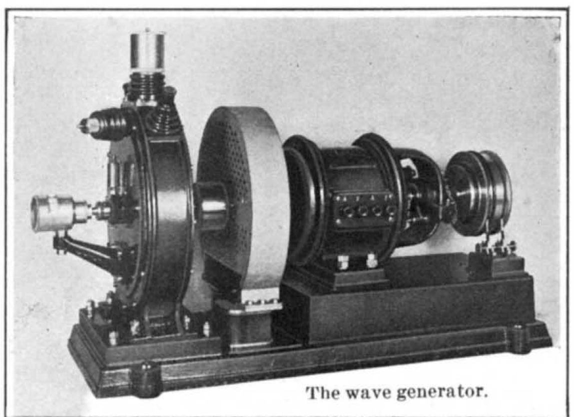
Experience has shown the wear and tear due to the milling effect between the toothed wheel and the brush to be extremely small. The brush is made of copper wire or of copper plate embedded in some insulating material, which has been found very helpful in damping vibrations.

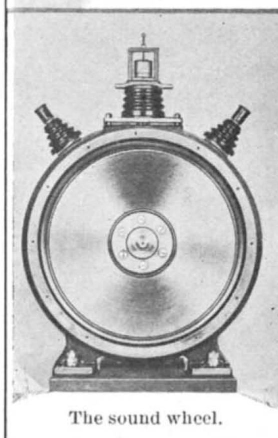
The wheel is actuated by a motor, the speed of which is controlled automatically by a centrifugal contact device and a Foucault current brake. The terminal supplying current to the wheel is placed as close as possible to the contact brush.

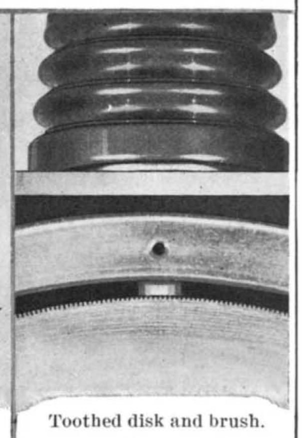
The "sound" wheel is at least equivalent to any one of the detectors so far known, as far as its sensitiveness is concerned. It has been used with most satisfactory results in the transatlantic service of Messrs. Hochfrequenzmaschinen A. G. (High Frequency Generators, Ltd.) between their stations at Eilvese and Tuckerton, respectively.

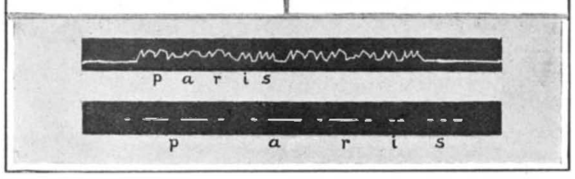
In a recent paper, Dr. Goldschmidt sums up as follows the main advantages of the sound wheel:

1. Damped waves are received as noises rather than sounds.
2. Stations using slightly different wave-lengths are heard with widely different pitches. If, e. g., the sound wheel works at 39,000 revolutions per minute, while the transmitting station gives out waves of 40,000 cycles, a sound of 1,000 cycles will be received. Another station using a wave 2½ per cent shorter, that is, of 41,000 cycles, would already be heard with a sound of 2,000 cycles, that is, twice the above, which, of course, makes discriminating between different stations very easy.
3. The sounds heard in the receiver come out most clearly against any atmospheric disturbance.
4. Each telephone, of course, responds best to a given note. As, however, the pitch of sound is adjusted at will, the one corresponding to the optimum of the receiver can be readily selected. In fact, the receiving intensity may thus be reinforced at the ratio of 1:10.


The wave generator.


The sound wheel.


Toothed disk and brush.

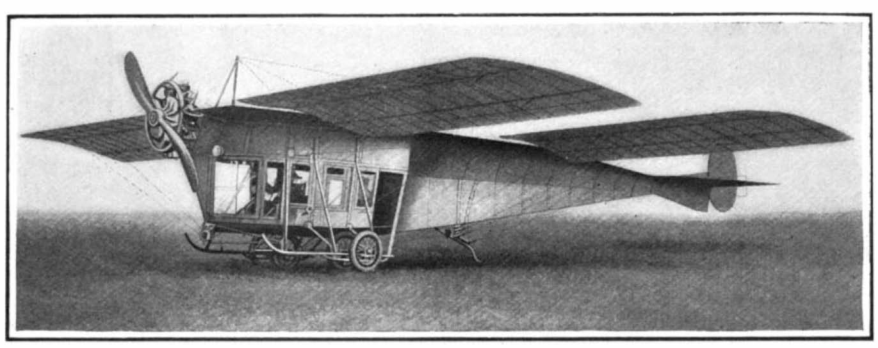


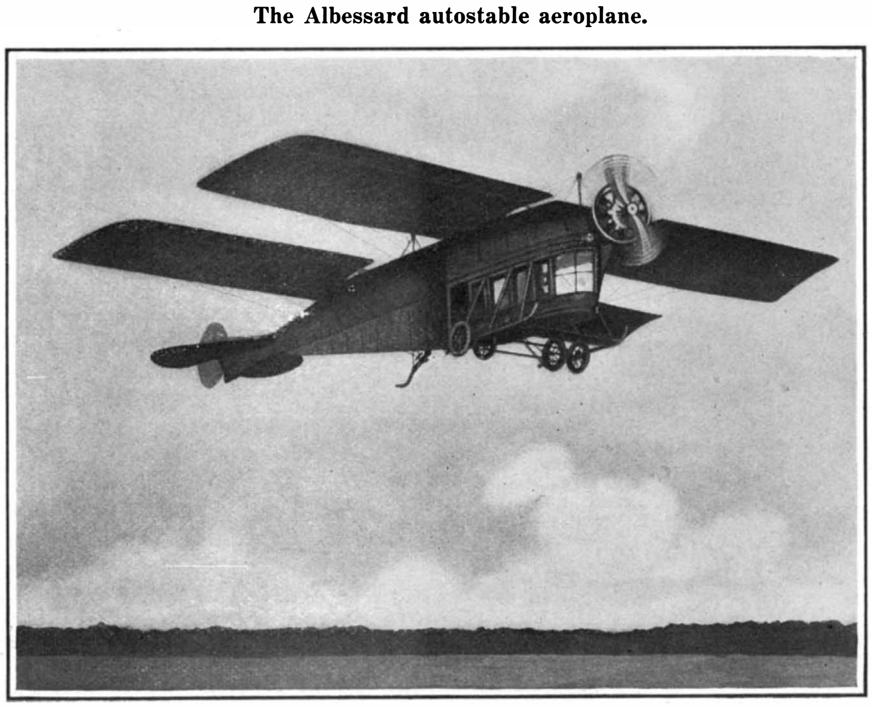

**Radio-telegram received with ordinary detector (above) and with sound wheel (below).**

In view of the remarkable sensitiveness of the sound wheel, Dr. Goldschmidt has made a series of experiments on this apparatus combined with a recording galvanometer. The most striking result brought out by these experiments is the fact that radio-telegraphic signals are received, not as a zigzag line, as in the case of ordinary telegraphic recorders, but in the form of a series of dots and dashes, corresponding to the Morse alphabet. Atmospheric disturbances make themselves felt at most in the form of slight deformations of these dashes.

## The Albessard Aeroplane

AUTOMATIC stability and the comfort of passengers are the objects chiefly sought in the construction of the Albessard aeroplane, which is described in a recent issue of *L'Aérophile.*


**The Albessard autostable aeroplane.**


**The Albessard aeroplane in full flight.**

The body, or fuselage, is sharply pointed behind, but blunt in front, and is entirely covered. The forward portion forms a spacious cabin, inclosed by glass sashes, which protect the pilot and passengers from the wind and the fumes of the motor. The long and broad top of the fuselage is perfectly plane and is level in horizontal flight. Hence, it contributes nothing to support, but it opposes little resistance to the air and it assists in maintaining equilibrium.

The machine is supported by two pairs of wings, arranged in tandem in the same plane, like the wings of a dragon-fly. The wings are equal in area but are not equally loaded, as the front wings are more inclined than the rear wings. This arrangement also contributes greatly to horizontal stability. The distance between the two pairs of wings is sufficient to prevent "blanketing," as has been proved in trial flights.

The wings are provided with a warping device, as a measure of precaution; but in practice the machine is found to maintain its balance without the intervention of the pilot, because of the novel arrangement of its central surfaces, its deep vertical keel, and its low center of gravity. The steering and elevating rudders are at the stern, the tractor screw at the bow.

In trial flights the aeroplane maintained a remarkably straight and regular course. A very gentle landing can be effected by gradually stopping the motor, without using the elevator. No mishap has yet occurred in landing.

The dimensions of the machine are:

| | | |
|---|---|---|
| Total length of fuselage............. | 46 | feet. |
| Width of horizontal top............. | 8 | " |
| Depth of keel, at junction with cabin ........................... | 5¼ | " |
| Width of cabin........................ | 3 | " |
| Width of each wing................ | 16½ | " |
| Length of each wing................ | 7¼ | " |

On the ground the machine is supported by a strongly built chassis, mounted on four orientable wheels.

The tractor screw, about 9 feet in diameter, is driven by an Anzani motor of 85 to 100 horse-power. This motor, however, has proven insufficient for a machine of this size and weight, and a new series of trials will be made with a motor of 160 to 200 horse-power.

The experimental machine in its present condition and unmanned weighs 1,760 pounds, and develops a speed of 46 to 47 miles per hour.

## An Investigation of Vegetarianism

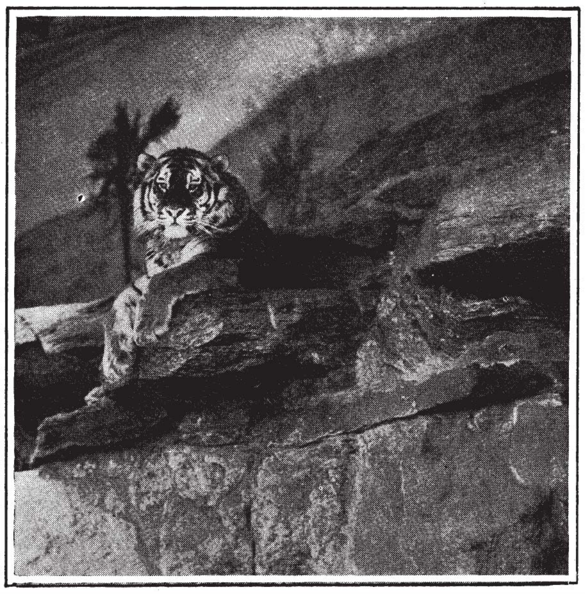
WHAT is there in a vegetarian diet that makes its enthusiastic advocates so staunchly defend it against all criticism? We hear much of the value of suggestion nowadays in treating a wide variety of maladies. After reading the report of one of our most noted investigators, Dr. Benedict, on work done in collaboration with Paul Roth in studying the effect of a vegetarian diet upon the human system, one wonders if, after all, it is not the idea as much as the diet that is efficacious in bringing about good health.

In at least two instances it has been proved by these investigators that the arguments made by vegetarians for their particular brand of diet are fallacious. It is claimed by vegetarians that a diet containing an appreciable amount of protein over-stimulates the process of digestion and assimilation.

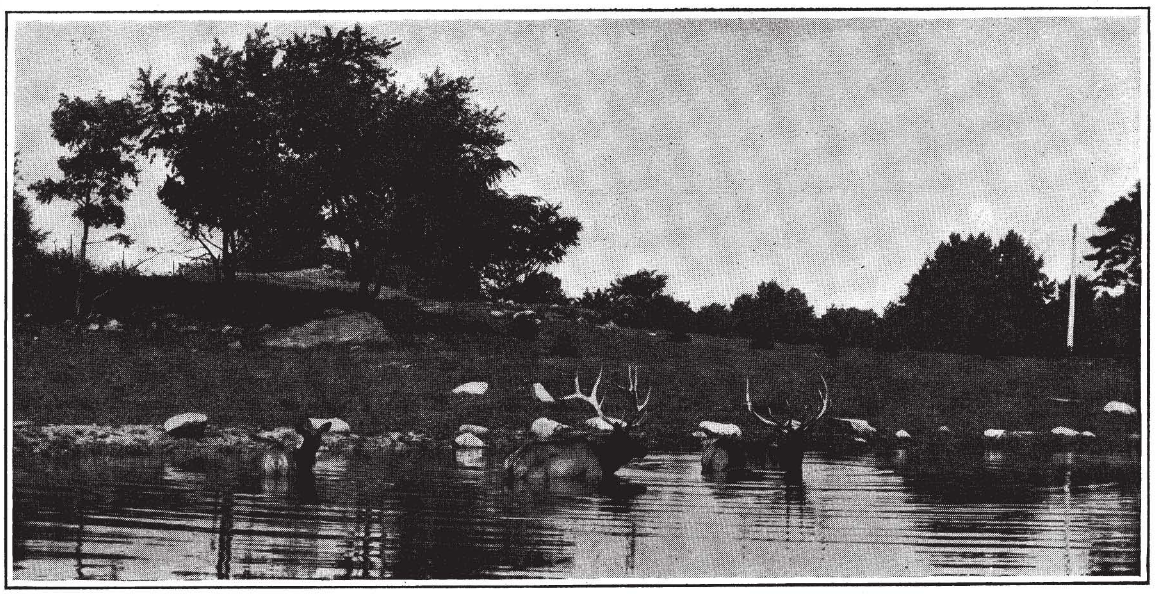
According to the writers, the best method for testing this, and one which is considered very satisfactory, is a comparison of the basal gaseous condition of the two types of eaters. By the term basal gaseous condition is meant the amount of carbon dioxide produced and oxygen consumed when the body is in complete repose at least twelve hours after the last meal has been eaten.

In the experiment, respiration records, obtained by means of a special apparatus used in all work of this kind, were made on several consecutive days on eleven men and eleven women, nearly all of whom had not eaten meat for several years. Records were taken also for the same number of men and women of similar weight and height who were meat eaters. When the two sets of data were compared they were found to be alike almost exactly.

The second assertion made by vegetarians which was put to test was that meat eaters have less endurance and strength than have those who eat a minimum amount of protein. This claim is based on the assumption that those whose diet consists largely of carbohydrates will have stored up in their body a larger quantity of glycogen, which during periods of muscular activity is converted into energy. But the test disclosed no superiority of vegetarians over meat eaters.



Quite content on his lookout.



Elk enjoying a cooling dip in a lake at a zoo.

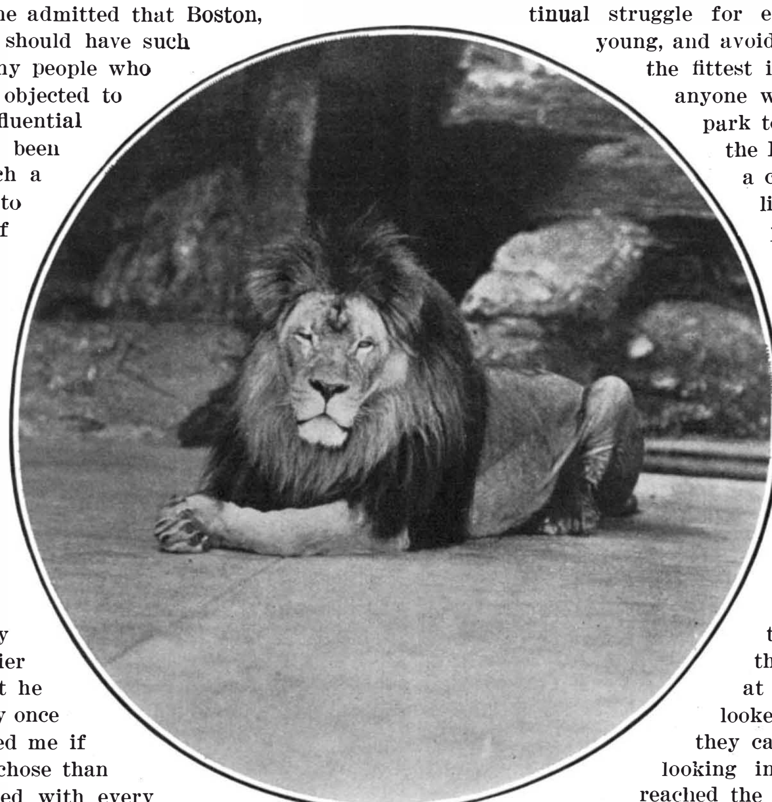
# Animal Life in a Zoo

## The Modern Way of Keeping Wild Animals

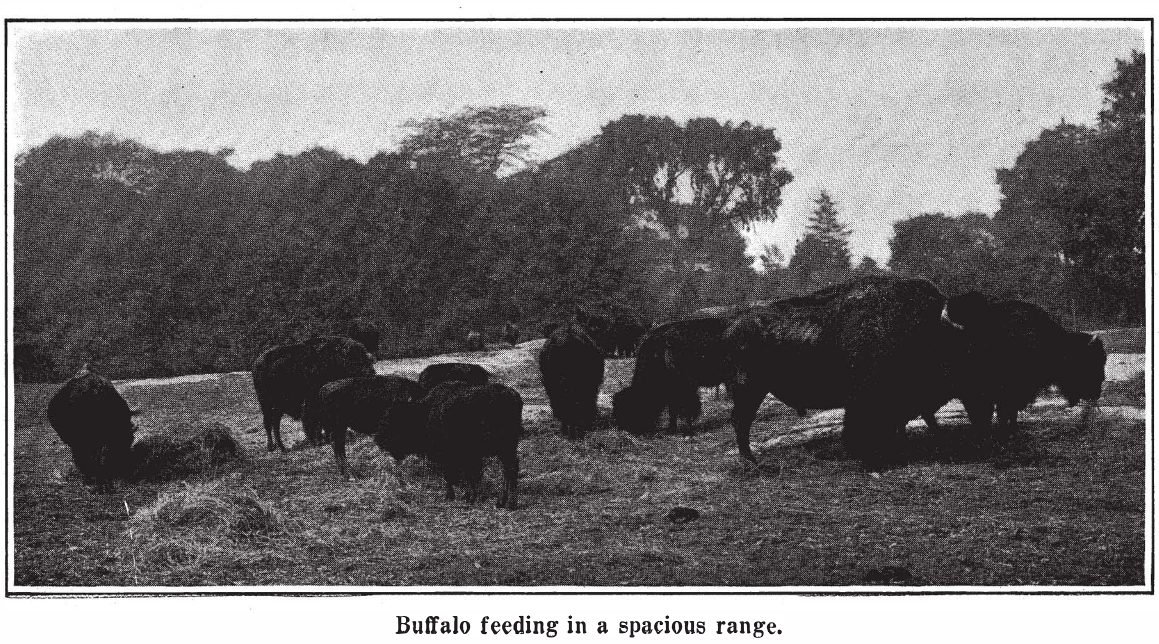
By Alexander Pope

SIXTEEN or seventeen years ago, when I first tried to interest the animal lovers of Boston in a zoological park, almost everyone admitted that Boston, like most of the prominent cities of the country, should have such an institution. There were, however, a good many people who called themselves the "friends of animals," who objected to it on the grounds of cruelty. One friend, an influential newspaper man, whose assistance would have been of great value in organizing and promoting such a project, stated emphatically that he was opposed to the whole scheme, and he did not want to see "half starved animals pining for their liberty." Since our Boston Zoo has been started and he has seen the conditions under which the animals are kept, he has changed his ideas entirely. If, of all the animals in a zoo the newcomers could vote on the question of whether they should be allowed their liberty or continue in their present condition, I have no doubt that the vote would be overwhelmingly for liberty; I also have no doubt that if at the end of three months it were possible to get the votes of the same individuals, as to whether they would remain at liberty or return to the zoo, a large part would vote to return. Mr. Pocock, director of the London Zoo, once said that he believed a majority of the animals in his care were actually happier than in their wild state, and it is my belief that he was correct in his opinion. One of my own family once said that such a statement was absurd, and asked me if I shouldn't be happier being free to go where I chose than if confined in an elegant mansion and surrounded with every luxury except liberty? Perhaps if I were in fear of my life I might prefer the mansion with restricted liberty, but to compare a man's state of mind with an animal's is unreasonable. An animal does not have a man's hopeless feeling in confinement, he knows he is restrained for the time being, but he does not feel the shame and disgrace, the shattered hopes and ambitions of the human prisoner. Many persons who call themselves "friends of animals" know nothing of the conditions under which these animals live in a state of nature, and think that removal from large ranges, such as the deer and similar animals enjoy in the open, is more of a privation than it really is. There is one thing certain, and that is that the cruelty imposed upon animals in a zoological park is nothing to the cruelty shown one to the other, or rather by the stronger animals to the weaker, in a state of nature, the cat and the mouse being the most familiar instance. The life of all wild animals, from the smallest to the largest, is one continual struggle for existence, hustling for their food, rearing their young, and avoiding their enemies. It is the survival of the fittest, the fittest in this case being the strongest. I would advise anyone who has an unfriendly feeling toward a zoological park to read Mr. Charles Livingston Bull's book, "Under the Roof of the Jungle." Mr. Bull is a naturalist and a close observer of animals, and what he tells about life in the jungle he has learned from his own experience and observation in British Guiana. He says, "Everything in the jungle is in danger, everywhere stalks the grim specter." And again. "Life in the jungle is a tragedy, everywhere the killers lurk or roam—in the tree tops, among the trunks, down on the ground among the roots and underground, beneath the roots." Can such things be said of a zoo? Another convincing proof of the terror in which wild animals constantly live, is shown in Mr. Paul Rainey's motion pictures of the water-hole taken in the heart of Africa. A pair of antelope were seen coming out of the woods, into the opening where the water-hole was situated. Did they walk up to the spring as they would to a trough in a zoo, and drink what they wanted without any fear of interruption? Not at all; they came out a little way and stopped, looked and listened. Finding the coast apparently clear they came a little nearer, always cautiously and always looking in every direction for an enemy. Finally they reached the spring, and though very thirsty, they took only a few sips at a time, constantly looking and listening, always in danger. The same animals in a zoo have to take none of these precautions. At certain times of the day they do look intently and listen, not for fear of any enemy, but for their keeper, who brings them food. Perhaps these terror-stricken animals are happier than their civilized cousins in a zoo. Who knows? Perhaps the most contented animals in a zoo are the deer. These animals are always given a large range, generally with enough trees to provide shade if they prefer that to sunshine, and a shelter which they can use at night, if they choose. Their food is brought to them every day, and they have every opportunity to raise their fawns. There are no hunters or dogs to molest them, and nothing to cause them fear or anxiety. Man, their most dangerous and dreaded enemy

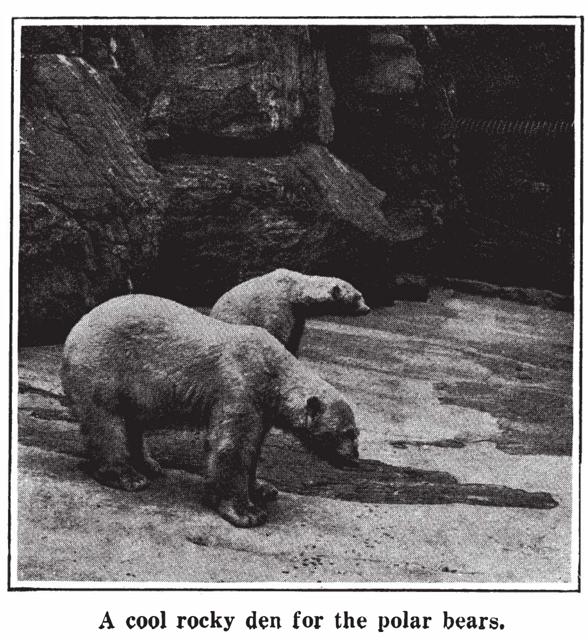
(Concluded on page 389.)



At dignified ease in his rock castle.



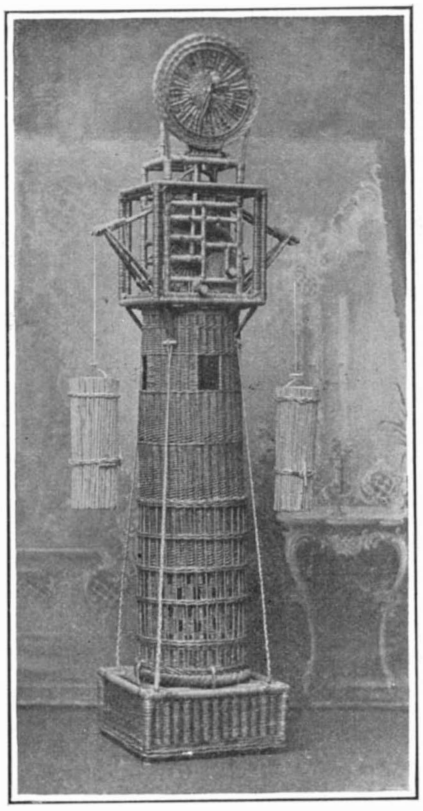
Buffalo feeding in a spacious range.



A cool rocky den for the polar bears.

## A Clock Built of Straw

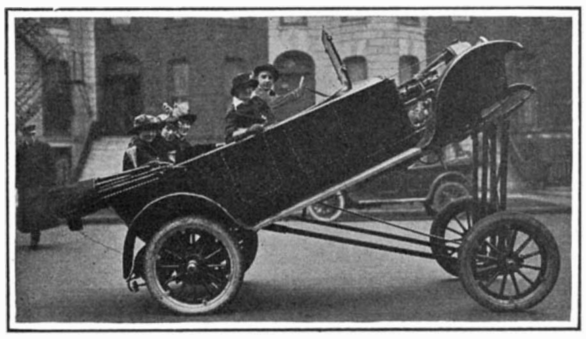
FROM Switzerland, the home of the watch and clock industry, comes the accompanying photograph of a clock made entirely of straw and willow withes. Of course there is no particular value in the use of this material, except to demonstrate the ingenuity of the clockmaker. In this clock there is not a single piece of metal. Even the chimes are made of straw put through a special process, so as to give them a ringing tone when struck. Instead of the ordinary swinging pendulum, this clock is provided with a see-saw movement, there being two weights on each side as shown in the photograph. One great difficulty in making the interior mechanism of the clock was to get the proper elasticity in the springs, which were pressed and turned into coils very much resembling Chinese bamboo. The clock is nine feet high with a face eighteen inches in diameter. The base is of wicker construction from which four heavy linked straw chains serve as guys to keep the clock properly balanced. The movement operates 24 hours on each winding. It took over thirty months to complete the clock.



A clock built of straw.

## Vacuum System of Gasoline Feed

SOME time ago the SCIENTIFIC AMERICAN illustrated and described a system of supplying the carbureter of an automobile with fuel by means of a vacuum system in place of the common gravity or pressure systems. The new method uses a small auxiliary reservoir, which draws its supply from the main tank, be it at the rear of the machine or under the front seat. It is the vacuum produced as the carbureter uses up the supply of gasoline that is utilized to draw the fuel intermittently from the main tank. As a supreme test of this type of gasoline feed, the automobile shown in the accompanying engraving was fitted with an elevated front truck which tipped it to a sharp angle. At this angle the carbureter is far above the gravity tank under the front seat, so that it could not possibly get any gasoline from that source. The same is true of any cowl tank in the dash, and at this angle no pressure system could possibly force gasoline to the carbureter. And yet despite this sharp inclination the car was operated with perfect satisfaction with the vacuum system. The angle of the car, according to engineering tables of grade, is approximately the limit where gravity overcomes traction, and no car could climb a steeper grade.



Ample fuel feed at any grade.

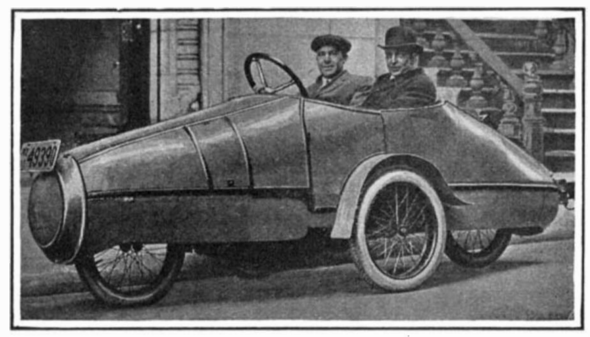
## Enormous Mass of Foam

AT first sight one would suppose that the mass of white shown beside the mill in the accompanying photograph is an ice jam. But it is on the wrong side of the mill dam, and, as the title indicates, it is foam instead of ice. This picture was taken on Rock Creek, Morrison, Ill. The foam was 85 feet wide, 40 feet deep, and 450 feet long. The ground had been covered with snow and there was a heavy rain, and the weather was greatly disturbed the day before the mass of foam began to collect below the mill-dam. It lasted about three days, and then gradually broke up and drifted away. It remained at its greatest dimensions for about two days. The novel sight was witnessed by hundreds of people, and could be seen for over two miles.

## The "Serpentina" Car

ONE of the greatest drawbacks in the handling of automobiles in the close traffic of a city, particularly where narrow streets prevail, such as in Boston, is the comparatively large radius required for a complete turn of the car. Some of the taxicabs in New York will turn in an ordinary side street, but by far the majority of motor vehicles need a street of the width of an Avenue to turn around in. To overcome this trouble two New Yorkers have designed a novel type of car which they call the "Serpentina."

Essentially the chassis differs from an ordinary roadster chassis merely in the arrangement of the four wheels. Instead of having these wheels in the orthodox fashion, in pairs at front and rear of the chassis, the "Serpentina" car has one wheel at each side in the center of the car, and one wheel at each extremity, front and rear. The steering arm is so arranged as to turn the latter wheels in opposite directions. As a result the car practically spins around on its center wheels, the front and rear wheels standing at right angles to the axis of the chassis. Traffic policemen stationed at important points, such as Columbus Circle, did not trust their eyes when the car showed up for the first time. The driver swung the steering wheel around just as the car reached the policeman, and it performed a pirouette of the most amazing swiftness. Before the surprised policeman could open his mouth it had darted off in a right-angled direction—after having described an arc of 450 degrees.



A car that can turn in its own length.

## An Electrically Operated Loader

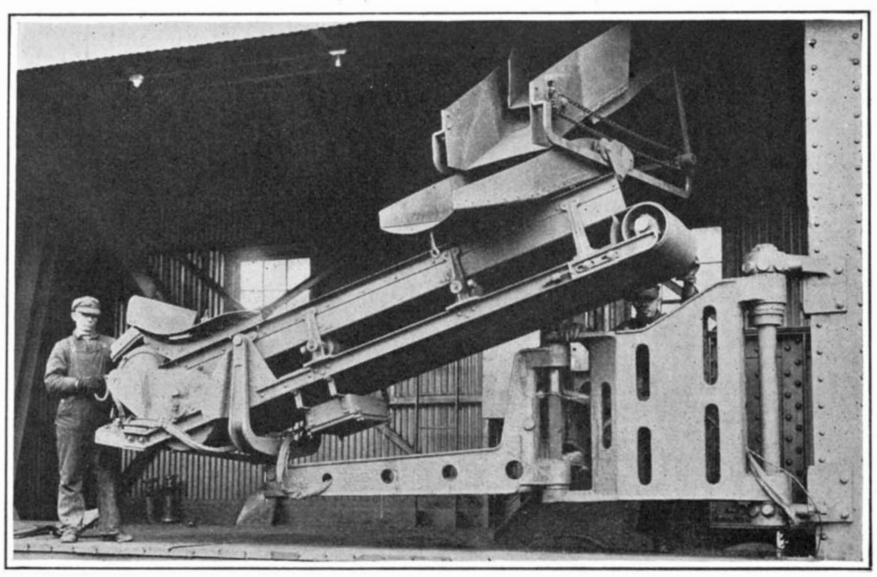
THE accompanying illustration shows the construction of a novel electrically driven belt loader for handling large lump lime without appreciable breakage.

This form of electric loader is really a conveyor supported on two arms hinged from a post in such a manner as to be easily moved into a box car by hand, coal or other loose material being conveyed into the car and piled to any depth by the machine with the least amount of breakage. The chute usually is on the loader side of the car and is flexibly attached so as to follow the loader in all positions. It is used to advantage for handling coal and similar material. The chute can be located on the opposite side of the car and a deflector at the receiving end of the loader turns the coal as it comes from the chute in the direction of the belt, thereby reducing the breakage of coal and increasing the life and capacity of the belt. In loading coke, the loader is partly withdrawn and the chute placed on the side of the machine in position to fill the center of the car.

In order to reduce breakage when starting to load, the conveyor is tilted toward the floor by turning a crank at the rear end of the machine. This is quickly and easily done because of the balanced construction of the loader. The jack for raising and lowering the loader to accommodate it to cars of varying heights is mounted on the loader post and can be easily operated by one man. This is only necessary for large lump coal.

The loader is made with 16-inch or 24-inch belt conveyer for loading sized coal or with 24-inch steel apron conveyer for

(*Concluded on page 390.*)



Belt loader for handling lump lime.

This is not an ice gorge, but an enormous mass of foam collected below a mill dam.

## RECENTLY PATENTED INVENTIONS

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

### Pertaining to Apparel.

CUFF BUTTON.—D. M. HENSLEY and E. M. SETHER, 123 South 2nd St., Decatur, Ind. The device connects the ends of cuffs of the link type, that is, where the ends are superposed face to face instead of being lapped upon each other, and wherein the button is formed from a single strip of material bent upon itself in such manner as to firmly clasp the ends of the cuff.

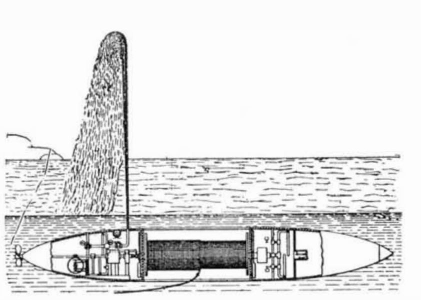
INITIAL BUCKLE.—L. SANDERS, 621 Broadway, New York, N. Y. The construction in this case permits of the letter plates being readily interchanged, insures their positive retention in position, and the form and arrangement of the face plate are such as to very effectively disguise its character as a means for holding letters, so that the interchangeable character of the letters is not obvious when the belt is worn.

PIN CATCH.—MARGARET L. NOXON, 205 W. 102nd St., New York, N. Y. The construction in this case permits of the use of the hat pin with hats of different types, and with the body or band disposed at the outer side of the hat, the pin tongue extending through the hat and coiffure of the person wearing the hat, and the point of the pin tongue being held by an S-shaped fastener.

SWEAT BAND FOR HEAD GEAR.—P. MERTON and C. S. MERTON. Address Charles S. Merton & Co., 810 Broadway, N. Y., N. Y. The sweat band consists of a lower strip of leather, chamois, or some similar material which can or cannot be washed, in conjunction with an upper strip of cloth primarily designed to match the interior of the hat or cap and to be sufficiently soft and flexible so as to permit the headgear to be blocked with the sweat band therein, thus avoiding the usual crease or ridge in the crown where hats or caps are blocked with the wide leather sweat band, especially due to its stiffness.

### Electrical Devices.

TORPEDO.—G. P. HELFRICH, 976 Fox St., Bronx, N. Y., N. Y. In this invention the construction gives a visual sign as the same passes through the water whereby the course of the torpedo may be easily followed. The propelling and controlling means may be adjusted so as to force the propeller forward and at the same time cause the same to move on



TORPEDO.

an even balance notwithstanding the pull of a wire connected therewith. An object is to provide a torpedo which is propelled by power from the shore and controlled by the amount of current supplied, thus allowing the torpedo to be steered from the shore and exploded at any time regardless of its speed and depth or direction of movement.

DEVICE FOR IGNITING FUSES.—J. H. REINEKE, Weitmar, near Bochum, Germany. By the present invention unintentional response of fuses is avoided by using alternating currents of high frequency for igniting the fuses and by connecting the fuses to the conductor in such a manner that continuous electric currents or alternating currents of ordinary frequency, which may enter the conductor, are not able to ignite the fuse, as this can only be effected with the assistance of a particular kind of current.

### Of Interest to Farmers.

BEATER FOR THRESHERS.—F. KERIAN, R. D. No. 4, Grafton, N. D. The inventor provides a beater which is disposed above the grain pan and the straw rack, the beater being constructed with a drum having annular grooves in which are journaled rollers which engage and reciprocate pivoted beater sticks which are prevented from lateral movement by the sides of the annular grooves.

PNEUMATIC PACKER.—V. N. PERRY, 507 Ellicott St., Batavia, N. Y. This invention provides a fan for use in pneumatic stackers, so arranged that the straw may be delivered axially of the fan directly to the blades or vanes, wherein the central control of the fan is free and unobstructed to receive the straw, and wherein a double blade construction is provided, the two portions of the blade being arranged one behind the other, the front portion being the straw blade and the rear portion the air blade.

MILKING MACHINE.—A. TRUCHOT, Choteau, Mont. The improvement provides a device by means of which the milking of a cow may be accomplished rapidly and economically and with no danger of injuring the animal. The device is of light weight and adjustable so as to permit the movement of the animal during the milking operation.

DAIRY REGISTER.—R. L. LACHAPELLE, Altona, N. Y. This is a device for keeping daily, monthly, and yearly records, being arranged particularly for cows, for the milk yield, and the character of the yield, of each of a plurality of cows, and the main object thereof is to provide means for keeping such records in a cleanly manner, and wherein the record of each cow for at least fifteen days is visible day by day, the monthly record of each cow for the preceding year for comparison, the total record of each cow for the current month or less, the total yield of all the cows, and other matters of importance.

MARKER FOR CORN PLANTERS.—R. E. MUDD, Stronghurst, Ill. This invention provides a marker for corn planters, which can be easily and quickly attached to any make of corn planter, which is operable from the driver's seat, and which will mark on any kind of ground, rough or smooth, hilly or level.

### Of General Interest.

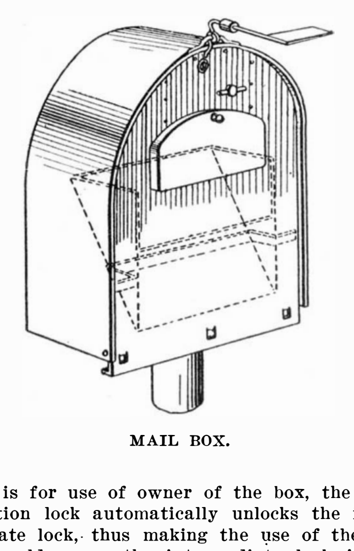
TOOTH BRUSH.—C. E. CARROLL, Newport, Ark. By arrangement of the tufts of bristles, the gums are massaged and their free margins are cleaned during the ordinary operation of brushing the teeth; also, by the arrangement of the angles of the tufts of bristles to each other and to the teeth, the roots of the latter and adjacent portions of the gums are thoroughly scrubbed.

PACKAGE TIE.—E. F. FORSGARD, 1122 N. 4th St., Waco, Tex. One of the principal objects here is to provide a tie with which the ends of a string that has been passed around a package may be securely held, without cutting or abrading the string, which would necessarily weaken the same.

STERILIZER.—D. W. BROOKS, Royston, Ga. The device is adapted for the simultaneous sterilization of a number of articles, such as drinking glasses for soda fountains, schools and other public places, wherein the articles are simultaneously washed or cleansed by boiling water, and wherein the articles are so arranged during cleansing that the contents may easily escape from the glass, and wherein the articles are thoroughly protected from breakage.

SEA ANCHOR AND OIL TANK.—L. KAHNWEILER and O. KAHNWEILER, care of Kahnweiler & Sons, 260 Front St., New York, N. Y. This invention refers to sea anchors and particularly to sea anchors provided with oil tanks, and has for an object to produce a construction of anchor co-acting with an oil tank secured to the anchor which is adapted to supply oil to the waves previous to their striking the anchor.

MAIL BOX.—C. F. UTTERBACK, Lock Box 201, Mooresville, Ind. This invention provides means manually operable for locking and unlocking the box, the lock mechanism being composed of a keyless and key lock combined, and having a middle or intermediate lock or latch. All keys are alike and are for use of the carrier only. The lower or combination



MAIL BOX.

lock is for use of owner of the box, the combination lock automatically unlocks the intermediate lock, thus making the use of the key very seldom, as the intermediate lock is for use of both parties and works on a plan like a safe. The box is provided with a target that is automatically raised when the door is open. The lock can be manufactured at a small cost.

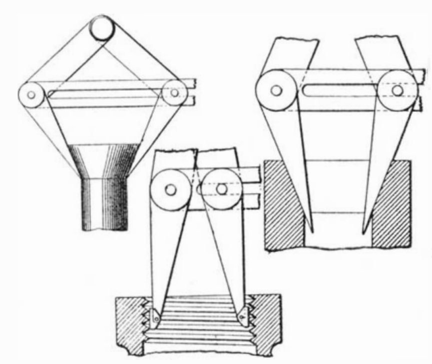
METHOD FOR LOCATING LIQUID STRATA IN A WELL.—T. A. BEECHER, Taft, Cal. The method has for its purpose the location of a liquid entering a well, and has reference more particularly to the location of water entering an oil or gas well, to which well water is very injurious, and therefore a water stratum must positively be shut off from the well to make an oil or gas well exploitable.

CULVERT FORM.—L. H. TOWNER. Address Benj. G. Wheeler, Surety Bld'g., Muskogee, Okla. This inventor provides a form consisting of sections that may be assembled to hold plastic material capable of hardening, as, for instance, concrete or the like in the proper shape, until the material has been hardened to a point where it will stand alone, and which then may be disassembled and removed to permit its reassembling at another point.

FOLDING TOOTH BRUSH.—L. KALINA, 384 Alabama Ave., Brooklyn, N. Y., N. Y. This invention provides a brush arranged to permit the user to conveniently extend the brush for use or to fold the same in a hollow handle with a view to take up very little room and to allow of packing the brush into a hand bag, vest pocket, valise or other receptacle without danger of the bristles coming in contact with other articles.

### Hardware and Tools.

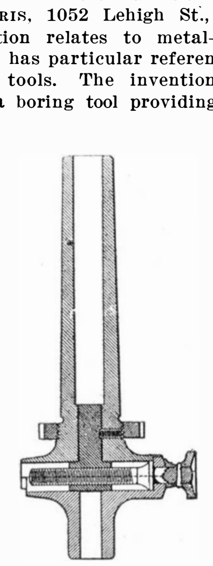
CALIPERS.—ANTONIO V. ESPINAL, Banes, Cuba. The invention relates to calipers and the object thereof is to provide such a tool which is adapted for use as a point compass, exterior and interior cone calipers, for determining angles of irregular articles or objects,



CALIPERS.

for determining the over-all diameters of exterior or interior screw-threads, and for a multiplicity of purposes, and which may also be folded into a very compact form, relatively as compact as a pocket-knife, for storing when not in use.

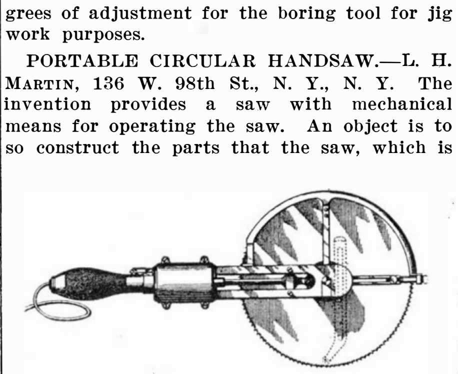
ADJUSTABLE BORING TOOL HOLDER.—W. C. MORRIS, 1052 Lehigh St., Easton, Pa. This invention relates to metal-working machinery and has particular reference to holders for boring tools. The invention provides a holder for a boring tool providing for delicate



ADJUSTABLE BORING TOOL HOLDER.

and accurate adjustments for various purposes, including the facilities for resetting a tool to the precise position in which it may have been set previously, and also to provide precise degrees of adjustment for the boring tool for jig work purposes.

PORTABLE CIRCULAR HANDSAW.—L. H. MARTIN, 136 W. 98th St., N. Y., N. Y. The invention provides a saw with mechanical means for operating the saw. An object is to so construct the parts that the saw, which is



PORTABLE CIRCULAR HANDSAW.

of the circular type, may be conveniently replaced as may be desired, either by a new saw or with a saw of a different size, or with teeth of any type to meet the conditions of use. (See advertisement on page 391.)

LEVEL.—T. COUGHLIN, 1208 Clay Ave., Bronx, N. Y., N. Y. This invention provides a level having a level member which is normally rotatably disposed to a circular opening in a frame, an annular flange being provided having orifices at recesses in a serrated disk and which register with threaded orifices in the level member, so that screws which are provided may be disposed in the orifices and in the recesses for holding the level member in adjusted position.

CORRUGATED IRON FASTENER.—M. A. MCCOY, Seaman St., Perth Amboy, N. J. This invention relates to devices for corrugated sheet metal, and an object is to provide a structure which may be quickly applied and removed. The invention provides a device in which a minimum number of parts are used without sacrificing any of the strength or retaining ability of the device.

AUTOMATIC SASH LOCK.—J. H. BARTON, Jones, Tenn. This invention relates to improvements in sash locks and more particularly to an improvement upon the structure illustrated in Mr. Barton's Patent No. 879,078, in that the device is automatic in its operation in engaging and holding the sashes against movement, that is, to prevent the upper sash from being lowered and the lower from being raised.

### Heating and Lighting.

PIPE SUPPORT.—W. B. GRAY, 1327 S. 22nd St., Louisville, Ky. The present invention is an improvement in pipe supports, and has for its object to provide a device adapted to carry a certain character of pipe used in heating systems, or for other purposes wherein the pipe is subject to expansion and contraction.

AUTOMATIC DAMPER. — A. W. ARNOLD, 1345 Elmdale Ave., Chicago, Ill. This invention relates to automatic dampers of the type comprising one or more pivoted wings adapted to hang normally by gravity open in the path of the draft in a stove pipe or furnace flue and having means for varying the automatic closing operation of said wings according to the variations in draft in said pipe or flue, due either to outside wind influence or draft caused directly by variations in heat within the stove or furnace.

THERMOSTATIC MEANS FOR OPERATING HOT AIR REGISTERS.—A. P. BROOMELL, York, Pa. This invention relates to improvements in devices for operating the registers of hot air heating systems, and an object is to provide a simple device which may be used in connection with a hot air heating system which will automatically open and close the register gates.

AUTOMATIC HEAT CONTROLLING DEVICE.—A. P. BROOMELL, York, Pa. An object here is to provide a device in which a thermostatic member is directly connected with a radiator valve so as to control the valve in accordance with the temperature of the room. Another object is to provide a device with means for regulating the device so as to cause the valve to operate at any predetermined temperature.

### Household Utilities.

EXTENSION TABLE.—D. F. OLIVER, care of Hotel Ponchartrain, Detroit, Mich. The purpose here is to provide a table having slidable end leaves, and extension leaves at the middle of the table, and adapted when not in use to be folded within the table rim, the arrangement permitting of readily moving the extension leaves into extended position flush with the end leaves.

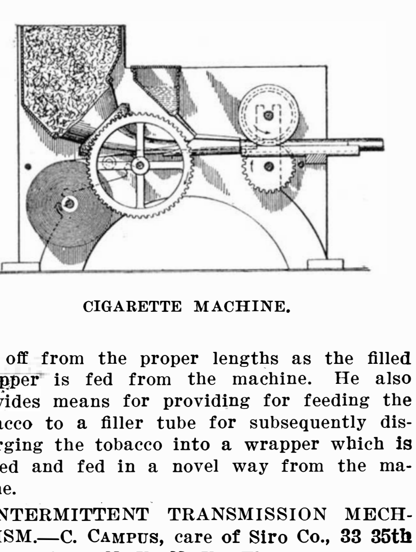
BEDSTEAD.—P. H. VOELKER and KARL KIMMICH, care of the latter, 1281 Putnam Ave., Brooklyn, N. Y., N. Y. Among the principal objects which the present invention has in view are: to provide a bed contractible lengthwise to accommodate variations in the rooms in which the bed is placed, and to provide for variations in the bed in correspondence with the service to which it is put.

DOOR HANGER.—S. J. WILLNER and G. FOLEEN. Address the former, 666 Irving St., Portland, Ore. The invention provides a hanger especially adapted for use with a series of doors or windows for hinging the doors and windows together and for connecting the said doors and windows to a track bar to permit the doors or windows to take a position in the same plane or in parallel planes.

### Machines and Mechanical Devices.

VARIABLE SPEED GEARING.—J. W. CAMPBELL, P. O. Box 40, Reno, Nev. The object here is to provide a transmission gearing by means of which various speeds may be imparted to the driven shaft, and in which the change from one speed to another is accomplished by means of clutch members without the necessity of shifting gears out of or into mesh with certain other gears.

CIGARETTE MACHINE.—E. C. GALLUP, 291 Broadway, New York, N. Y. This inventor provides a structure for the making of cigarettes from a continuous strip rolled to provide a wrapper and continuously filled with tobacco or the like, while the longitudinal edges of the strip are united so that the cigarettes may be



CIGARETTE MACHINE.

cut off from the proper lengths as the filled wrapper is fed from the machine. He also provides means for providing for feeding the tobacco to a filler tube for subsequently discharging the tobacco into a wrapper which is closed and fed in a novel way from the machine.

INTERMITTENT TRANSMISSION MECHANISM.—C. CAMPUS, care of Siro Co., 33 35th St., Brooklyn, N. Y., N. Y. The patent covers a new mechanical movement to convert a reciprocating into rotary motion, and is designed

**for different machines in which it is required to lock a driven rotary element at predetermined times.** A reciprocating member has a spring pressed transverse pawl to engage teeth on the driven element and actuate the latter step by step. The device includes means whereby the driven element is locked against retrograde movement, or accidental forward movement, between the regular forward impulses.

ICE BREAKING MACHINE.—A. G. KROCKER, Waco, Tex. The invention relates to ice breaking machines, and one of the principal objects is to provide a machine whereby cakes of ice may be broken up into pieces of the desired dimensions, in a quick and accurate manner and with a minimum amount of waste.

BUTTON ATTACHING MACHINE.—B. KOTKOVSKY, 172 Lorimer St., Brooklyn, N. Y., N. Y. In the present patent the invention has reference to button attaching machines of that type which includes a mechanism for making, driving, and clenching the staples whereby the buttons are attached to shoes, gaiters, leggings, and other articles. The machine is so designed as to be adapted for use with buttons of different sizes.

APPARATUS FOR DRYING MATRICES USED FOR STEREOTYPE PURPOSES.—C. WINKLER, Berne, Switzerland. This invention provides a device for automatically arresting the drum in a suitable position for taking out the matrices. The apparatus is, further, so constructed that, by closing or opening the door of the drum, the driving mechanism for the drum is simultaneously put in or out of operation. Means provide that on opening the door the cock is closed somewhat, while on closing the door it is opened.

ADJUSTABLE TABLE FOR WIRE CLOTH RACKS.—W. G. NEWMAN, 660 S. Main St., Salt Lake City, Utah. An object here is to provide a table which may be elevated or lowered and which may be locked in its shifted positions so as to form a cutting table and a measuring table for rolls of wire cloth screen which may be situated at different heights or at different portions of the rack.

AUTOMATIC GASOLINE SERVICE.—S. F. MIOTON, 2523 Esplanade Ave., New Orleans, La. While the device is adapted for dispensing varieties of liquids, the object primarily is to provide a means adaptable for supplying gasoline or the like for automobile use, at any time of day or night, and without requiring the presence of the owner or attendant to assist in such delivery.

ROLL MILL FOR HARD MATERIALS.—H. ALDEHOFF, Berlin, Germany. In this new mill an output of 3,500 kilograms of finished cement is obtained when only 10,000 kilograms of raw material are passed through the machine. This increase over existing mills is double and is explained by the fact that the rolls and grinding ring are kept free from fine material, so that the material which is still coarse is not subjected to the grinding action in a bed of fine material. A further advantage is that the transport apparatus has less material to deal with, so that less power is required.

### Prime Movers and Their Accessories.

ROTARY STEAM ENGINE.—E. V. MACK, 327 E. Palmetto St., Florence, S. C. This invention provides a rotary steam engine which is very compact, perfectly balanced, composed but of few parts, not liable to get out of order, and arranged to run at a high rate of speed and to utilize motive agent to the fullest advantage.

### Railways and Their Accessories.

MAIL BAG RECEIVING AND DELIVERING MECHANISM.—B. F. NICOLL, 4439 South Liberty St., New Orleans, La. The primary object here is not only to facilitate the delivery of mail with speed and dispatch to and from trains at a high rate of speed past stations where no stop is scheduled, and posts and other points along the route, but to increase the efficiency and capacity of such devices, whereby large quantities of mail may be handled according to governmental requirements with the idea of producing a standard device.

RAIL JOINT.—G. H. MARTIN, 108½ West 2nd St., Oklahoma, Okla. One of the principal objects of the invention is to provide a joint so constructed as to securely maintain the rail ends in position, without the use of bolts and nuts, which, as is well known, have a tendency to become loosened by the vibration given the joints upon passage of rolling stock therefrom.

CAR WINDOW CLEANER.—A. JOHNSON, 2384 First Ave., Manhattan, New York, N. Y. The purpose here is to provide a simple, strong, and efficient window cleaner which can be easily and quickly attached to or removed from a window frame and whereby the outer surface of the window can be wiped from within without disturbing the window frame.

BRAKE SHOE.—J. E. WORSWICK, 215 N. Lawrence St., Montgomery, Ala. The shoe is for use with car wheels of every kind, and especially for use with chilled cast iron wheels, wherein the elements constituting the shoe are so arranged that when the shoe is in contact with the wheel, a maximum of braking efficiency will result with a minimum of heat evolution, and wherein the shoe will dress the periphery of the wheel at every point except where the wheel is engaged by the rail.

### Pertaining to Recreation.

CHAIR SIGNAL FOR THEATERS.—J. J. MCCOMISH, 36 W. 128th St., New York, N. Y. The purpose here is to provide a method whereby the unoccupied chairs in a theater or darkened hall may be quickly and easily located by the attendants, or by persons looking for seats. The invention provides a means for determining when two such unoccupied chairs are adjacent to each other, in the same row of chairs.

### Pertaining to Vehicles.

PNEUMATIC TIRE FOR ROAD VEHICLES.—E. R. DEVEREUX, 2-4 Avenue Chambers, Southampton Row, London, W.C., England. This invention is designed to provide a tire in which the abutting ends of the segments are strengthened so as to resist the tendency of such segments to burst when in use. In combination with the segmental inner tube of the invention, the inventor provides a laced-on cover which allows of any punctured segments being removed and repaired.

DUMPING WAGON.—J. J. MCGUIRE, 48 W. 142nd St., New York, N. Y. The improvement has for an object to provide a structure which may be readily dumped and again readily restored to its original position. It also provides in a dumping wagon means for automatically removing the end or tail-board as the wagon is dumped.

CHAIN TOOL.—E. P. MCGUIRE, Van Houten, New Mex. By means of this tool the non-skid or mud chains used on automobile wheels may be tightened. The invention provides a tool including a double rack bar having a hook at one end to engage one end of the chain, and a lever provided with pawls for co-operating with the rack bar, the lever carrying a hook for engaging the opposite end of the chain.

ASH CART AND CAN.—H. KASTOR, 125 E. 23rd St., New York, N. Y. The inventor provides a contrivance which will automatically bring into register the top of the can and the opening in the cart by uncovering the cart and can during the up-turning movement of the can to deliver the contents into the cart, and which will restore the covers to their original positions when the can is turned to its normal position.

DEMOUNTABLE RIM TOOL.—M. M. HERMAN, 301 Hennan Bldg., Danville, Va. The invention refers to tools for use in connection with demountable rims for motor vehicles and the like, and more particularly to a tool attached to, and detachable from, a rim to provide for its detachment from a tire disposed thereon, irrespective of the manner and means by which the rim is or may be demountably secured upon the wheel.

### Designs.

DESIGN FOR A BADGE OR SIMILAR ORNAMENT.—M. C. BARNARD, 36 Perkins St., Winthrop, Mass. In this ornamental design the badge is represented by four large sized 7's crossing one another, in the center of which is a circle holding the legend LUCKY SEVEN. Between these words is a space marked by seven up and down depressions.

DESIGN FOR A WOVEN AND PRINTED RIBBON.—R. JACOB and E. SPECK, care of Johnson, Cowdin & Co., 126 Fifth Ave., New York, N. Y. The ornamental design in this case represents a ribbon on which are bunched the characteristic flowers of the States of the United States of America.

DESIGN FOR A RADIATOR HOOD.—D. MC RA LIVINGSTON, 159 E. 36th St., New York, N. Y. In this ornamental design for a radiator hood there are three views. The first is a front presentation; the second a side elevation; and the third a rear perspective view. The design is highly original, graceful, and attractive.

DESIGN FOR A GLASS VESSEL OR SIMILAR ARTICLE.—T. B. CAMPBELL, care of T. B. Campbell Co., 40 South 8th St., Brooklyn, N. Y., N. Y. This is an ornamental design for a cut glass vessel.

DESIGN FOR A NECKTIE.—A. BENNETT, 123 Prince St., New York, N. Y. In this ornamental design for a necktie, the tie consists of a round tufted cord ending in a tassel.

---

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

---

## Illumination of the Panama-Pacific International Exposition

(*Concluded from page 378.*)

proceeding from a giant battery consisting of forty-eight searchlight projectors, each with a 36-inch lens. These fling an aurora of colored lights into the heavens. The battery, manned by a trained crew of operators and handled with the precision with which a gun crew is operated, has behind it a force of 2,600,000,000 candle-power.

In addition to these four principal sources of lighting, there are several minor sources. In various parts of the grounds are globes of white glass, the light from which, at night, dissipates the shadows beneath the palms and other foliage upon the exposition grounds.

In the great central Court of the Universe a similar principle is employed. In this court two lofty columns of dense white glass are parts of the sculptured Fountains of the Rising Sun and of the Setting Sun. These fountains are a principal source of the night illumination of the Court of the Universe and give forth a soft white light which penetrates to the farthest recesses of the court.

The globes of light and also the columns in the Court of the Universe are in harmony with the principal purpose in the illumination of the exposition to employ no direct lighting. In all instances except the last two mentioned the light is concealed, and in these last two it is diffused through the heavy glass.

The maneuvers of the batteries of searchlights and the interior illumination of the Palace of Horticulture leave nothing to be desired in the way of spectacular or pyrotechnic effects, while the illumination of the exposition as a whole presents every advance developed in the lighting of municipalities. The lighting of the exposition was planned and executed by Mr. W. D'A. Ryan, consulting engineer of the General Electric Company.

## Animal Life in a Zoo

(*Concluded from page 385.*)

in the woods, becomes their best friend, and they will frequently come at his call to receive his caress. We don't hear the "friends of animals" protesting against the treatment of the farmer's cow. True, she is a necessity, but she does not know that, and the fact does not make her any more willing to have her head confined between two poles all night, so that she cannot turn around, nor any more contented to have her calf sent to the slaughter house when she was just beginning to enjoy the pleasures of motherhood. I have seen more agony expressed by a cow when her calf was taken away from her than I have ever seen by any animal in any zoo. Mr. Bull tells of an otter in British Guiana, larger than our kind, that found a gallinule's nest and bit the heads off all the young ones. He didn't eat them, he wasn't hungry, he just did it in the spirit of play and as a working out of a primal instinct. He then took one of the little fluffy bodies and played with it as a cat plays with a ball of worsted. He took it into the water and threw it up in the air, dove under it and came up with it on his back, dove again and appeared with it on his neck. I have watched an otter in the Washington Zoo go through a similar performance, only in the place of the young bird he used a flat stone. He would throw the stone into the pond in his inclosure, dive, and come up with the stone on his forehead. After exhibiting his skill to the many visitors who were watching him, he threw the stone into the water again, and, just to show it was not accidental, he repeated the performance. He was evidently having a very good time, just as good as his distant relative in the jungle, and he did not deprive any mother bird of her nestling.

There is one class of animals that doubtless is more unhappy in its confinement than in the wild state, and that is the large cats, the lions, tigers, etc. They don't have many animals to fear, but all the smaller and weaker animals fear them. Each lion takes a yearly toll of from fifty to one hundred harmless, beautiful ani-

mals, and, of course, in a zoo he is prevented from carrying on his wholesale slaughter, and he doesn't like it. It irritates him and makes him unhappy. But why show so much sympathy for this brutal murderer, why not extend your sympathy to the scores of perfectly harmless animals whose lives are spared by this one lion's confinement. "But," says the "friend of animals," "the lion is only obeying the laws of nature." Very true, the cat is obeying the laws of nature when she eats a canary whose cage has carelessly been left within her reach. The canary, by the way, in its pretty brass cage, is more of a prisoner and more confined than any bird in any zoo that I have ever visited, yet the owners of these pets have a kindly feeling toward animals and do not realize the cruelty of keeping their little birds in such narrow quarters where they can never spread their wings in flight or mingle with their own species, both of which privileges they would enjoy in a well equipped zoo. Nearly, if not all, the laws passed in this country for the preservation of wild birds, have been suggested and advocated by sportsmen, real sportsmen, not pot hunters and plume hunters; while the cruelest slaughter of wild birds, the traffic in aigrets torn from the backs of the snowy egrets while rearing their young, thereby killing the young as well as the old birds, is patronized and made possible by women only. Surely while women demand these ornaments the egret in a zoo is far better off than those in the southern swamps within range of the plume hunters. The late Arthur E. Brown, director of the Philadelphia Zoo, was a most kind-hearted man, and a true friend of animals. He told many amusing suggestions he had from kind-hearted people, meant to improve the conditions of the birds and animals in his care. A lady who was a constant visitor at the zoo, and also a liberal contributor toward its maintenance, told him she thought the hawks suffered at certain times of the day from the sun, and asked him if he would have an awning put in the cage at her expense. He thought it unnecessary, but promised to have it done. One day soon after it was installed, and while the sun was at its height, the lady called to see the result of her experiment, and found the hawks all sitting in the sun, *on top* of the awning.

Many instances could be told of wild animals that have been kept in captivity being offered their freedom, and refusing to avail themselves of it, preferring the civilized life.

Remember that everything in the jungle is in danger, "everywhere stalks the grim specter." In the zoo not an inmate of any kind has a single enemy to fear, and everything possible is done for their comfort. To you a zoo may seem a prison, to others it is more of an asylum, and the loss of absolute liberty is compensated for in most cases by all absence of fear and danger.

### An Electrically Operated Loader

(*Concluded from page 386.*)

large lump coal. The 24-inch steel apron loader is similar in general design to the belt machine, but is heavier throughout and is provided with a 15 horse-power motor. The apron conveyor consists of beaded plates carried on roller chains of standard make, the apron on the return side running on angles projecting beneath its edges. Similar angles project beneath the upper edges to prevent spillage, but do not take any of the weight of the apron.

In order to prevent spillage of coal on the apron an angle is riveted to every fifth plate, thus assuring a positive discharge. Guides carry the roller chains directly to the pitch line of the sprockets and prevent all hammering. They are bolted in and can be quickly and easily replaced when worn out. This machine is tilted by power and the arms are provided with a lock which keeps the loader in position either when loading or when out of the car. A screw jack with ball thrust bearing makes it possible for one man quickly to raise or lower the loader as conditions require.

The 16-inch belt machine will load at

the rate of four tons of coal per minute, the 24-inch machine will load six tons per minute, and the 24-inch steel apron loader eight tons per minute. As two minutes are required to get the loader in and out of the car, to attach and detach the chute and to change from one end of the car to the other, the time required to load is two minutes, plus the actual time the coal is running, determined from the above rates and size of car. This, plus the average time to spot the cars divided into sixty, gives the actual rate of loading in cars per hour.

### Continuous Aviation Competitions

MOST elaborate plans have been made by the Aero Club of America, in co-operation with its affiliated clubs, some twenty-five in number, for a series of daily competitions continuing from July 4th. This competition is to be for the greatest distance covered in ten hours during the ninety days, and those making the best records will be awarded prizes, including a special daily prize of $100. Flights may be made from any of the official aerodromes, to be designated in various parts of the United States, and any or all of the aviators may start each day.

These competitions are designed to assist the Army and Navy Departments in developing aviation corps for the National Guard and Naval Militia, to demonstrate for the Post Office Department the practicability of carrying mail by aeroplane to the hundreds of isolated places where it now takes days to deliver mail which could be delivered by aeroplane in a few hours, and to develop the sport in general.

The competitions are on the same plan as those for the Pommery Cup, in France, which resulted in great benefit to the sport in that country, and developed many remarkable performances.

Nine prominent aviators and constructors have already made known their intention to enter these contests, and it is gratifying to the committee that all the entrants so far propose to use American made aeroplanes and motors; and it is an encouraging indication of the interest aroused, and the progress made since our Government has shown an indication of its intention to increase the use of aeroplanes in the Army and Navy.

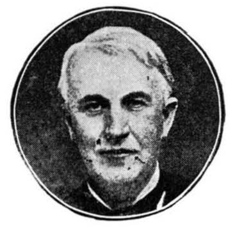
It is expected that among the contestants will be Lawrence B. Sperry, with two machines, one a regular land aeroplane and the other a flying boat, both equipped with gyroscopic stabilizers.

### The Current Supplement

THERE has been considerable discussion from time to time on the effect of electricity on plant growth, as applied to agriculture, and some experimental work has been done. A *résumé* of the literature on this subject, with notes on the experiments, is given in the current SUPPLEMENT of the SCIENTIFIC AMERICAN, No. 2051, for April 24th, 1915, which will be of value to those interested either in electricity or agriculture. There are plenty of excellent automobiles on the market that have been used a short time and are still as good as new, and many people would be glad to buy them if they knew how to select a good car. An article by an expert tells the tricks of the second-hand trade and describes the points to be looked to when buying a used car, and there is a full-page drawing that illustrates the points raised. The Treasures of Lahun tells about the discovery of some remarkable jewelry, ornaments, and tools found in an Egyptian pyramid, which had escaped plunderers for many ages. There is an interesting summary of the method used in determining the Washington-Paris longitude by radio signals; also an article of interest to surveyors that tells how to make hour angle observations of Polaris by daylight. The story of the Roosevelt-Rondon scientific expedition in South America is concluded, as is also the valuable article on the Wireless Transmission of Energy, an article as interesting to the layman as to the scientist. How Narcotics Affect Plants is a brief summary of a paper by a foreign authority.


ERICSSON


MORSE


EDISON


BELL


WESTINGHOUSE


HOE


WILBUR WRIGHT


ORVILLE WRIGHT


McCORMICK


DAIMLER


HENRY


PARSONS

*The*

# 70th Anniversary

## *Number of the*

# Scientific American

### June 5th, 1915

THE Scientific American was founded seventy years ago, at a time when the United States of America was industrially less developed than South Africa at the present time. Even territorially, it was not the same country we know now; for California, Texas, and the great Southwest belonged to Mexico.

During that long period of seventy years the Scientific American faithfully chronicled the technical and industrial progress which we Americans made. Its editors saw the advent of the reaper, the telegraph, the telephone, the great trans-continental railways, the laying of the transatlantic cable, the development of the giant steamship, the perfection of the phonograph, the glow of the first electric incandescent lamp, the coming of the motion picture machine, the miracles wrought by wireless telegraphy, and more recently the conquest of the air.

What an age of wonders it has been! What a transformation has been wrought upon the face of the earth! Surely no tale of the Arabian Nights, no fantasy of Jules Verne depicts marvels so amazing as those which the Scientific American has been the first to describe authoritatively as soon as they appeared. Who would have thought, seventy years ago, that with the aid of the X-rays we could look through a man's body; that friend could talk with friend from New York to San Francisco; that Niagara Falls would illuminate cities; that street cars would move magically through our towns without any apparent means of propulsion; that pictures would be sent by wire from New York to Chicago, and that by means of the boundless ether a solitary passenger ship on a desolate ocean still keeps in touch with civilization.

It has been the privilege of the Editors of the Scientific American to know the men whose master minds have wrought these things, and to hear from their own lips the story of their struggles and their triumphs. Ericsson, Morse, Edison—the whole dynasty of inventive genius which has made the nation what it is—the editors have known them all.

Seventy years is a turning point not only in the life of a man, but in the life of any enterprise. It seems fitting that the occasion should be commemorated by the publication of a number which will review the progress that the United States of America has made in the three-score years and ten of our existence.

In June a number will appear which the Editors hope will do full justice to the great theme of American invention—a number which will transport us all back to the time when our fathers and our grandfathers still burned candles, when horses pulled street cars, when there were no automobiles and when the steam railway was a curiosity that people would travel miles to see. The motion picture machine of industrial progress will be turned backward, and the flickering film will make you wonder what the future will have in store if so much that is wonderful has happened in the past.

**Munn & Company, Inc.**

**WOOLWORTH BUILDING, NEW YORK**


TESLA


MERGENTHALER


MARCONI


HOWE

# SCIENTIFIC AMERICAN

*The European Infantryman's Rifle*

*The Bullets of the Fighting Nations*

*Machines for Treating Wounded Soldiers*

*How the Allies' Ships Were Sunk in the Dardanelles*

Vol. CXII. No. 18
May 1, 1915

Munn & Co., Inc., Publishers
New York, N. Y.

Price 15 Cents
$3.00 A Year

# Which of these three Motor Car Dollars is yours?


The too Light car dollar


The too Heavy car dollar


The Chalmers dollar

It used to be 960 miles from Chicago to New York. Now it is 20 hours.

How rapidly we shift—and better—how rapidly we shift our standards of measurement!

Motor cars have been in turn measured by appearance, design, construction, price, power.

Now these things are pretty well standardized in all the different priced motor cars.

The things by which the motor-wise man now measures is *cost of upkeep.*

You can get upkeep cost down to nearly nothing—but not if you get what you demand from a motor car.

And here comes the discussion about weight.

Someone asked Abraham Lincoln how long a man's legs ought to be.

"About long enough to reach from his body to the ground, I should say," replied Mr. Lincoln.

And a motor car needs enough strength to carry its necessary weight—no more—no less.

Saving on gasoline and oil may be saving at the spigot, to run out at the repair bung hole.

Between any two cars—there are only a few dollars' difference in a season's oil and gas cost, but parts and repairs cost to beat the band.

Good tires are all adjusted to your car and sold on a guaranteed mileage basis.

So you should demand that your car should be heavy enough to stand up on country roads without danger or big repair bills; light enough to be reasonably economical of gas and oil.

Among this kind of motor cars, the Chalmers car is supreme when you consider the cost of the motor car while you *have* it, instead of its cost when you *get* it.

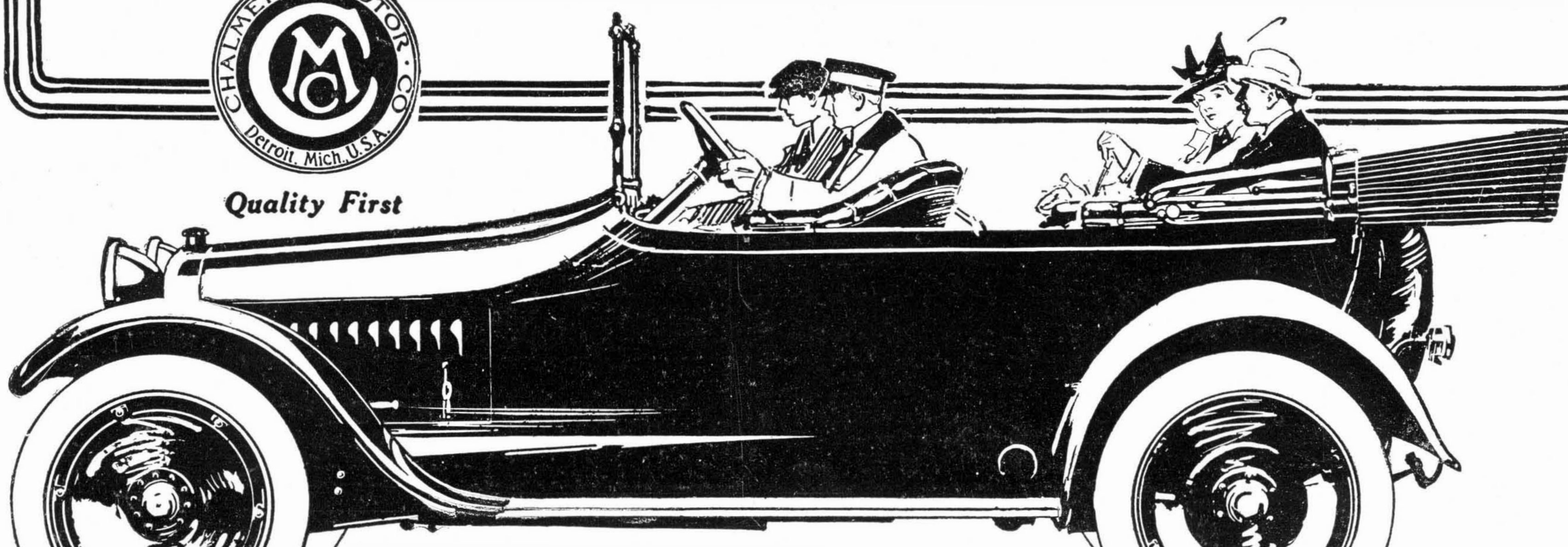
The Chalmers line for 1915 consists of 3 "Economical Sixes;" the New Six-40 at $1400; the Light Six-48 at $1650 and the Master Six-54 at $2400.

*Go to the nearest Chalmers dealer's and look them over.*

Chalmers Motor Company, Detroit

CHALMERS MOTOR CO. Detroit, Mich. U.S.A.

*Quality First*



Let your next Car be a
**Chalmers Light Six-48 $1650**

# Goodrich SILVERTOWN CORD

## CORD IN NAME - CORD IN CONSTRUCTION

## The Great Tire

that has won the highest regard without grand-scale exploitation or glittering appeal for favor. In this particular, if no other, the SILVERTOWN Cord Tire occupies a position as unique as it is individual and inviting.

For three years it has delivered a tire service with fewest limitations and greatest freedom from the common causes of tire trouble—All because of the exclusive

## TWO PLY, RUBBER COVERED, RUBBER IMPREGNATED, CABLE CORD CONSTRUCTION

which involves a hundred perfected details—the logical result of continuous experience, experiment, and invention (in respect to pneumatic tires made of *two plies* of isolated strands) which we began in 1895, twenty years ago.

The construction is protected by United States patents controlled by the B. F. Goodrich Company.

**No Other Tires Embodying the Silvertown Principles Are Made or Sold in the United States**

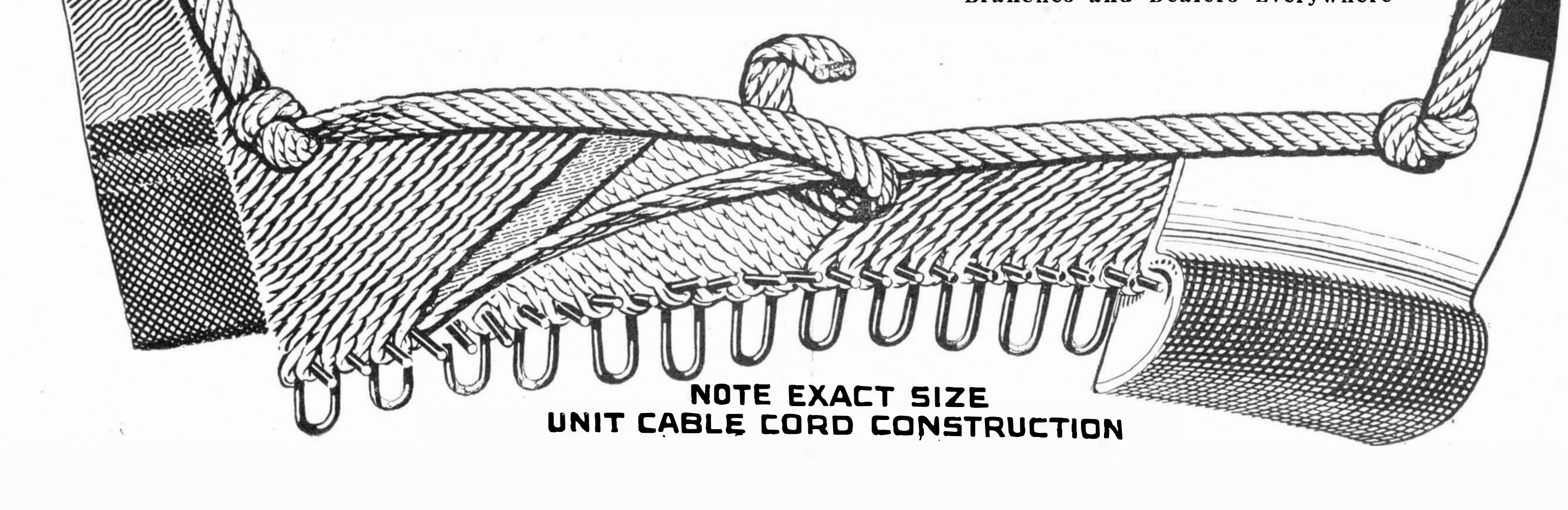
Bear in mind SILVERTOWN is the word that identifies the only cord tire that alone can employ the construction, methods and experience necessary for your expectations.

Why not investigate? There's a Goodrich branch in a hundred big cities and a Goodrich dealer everywhere

***"If it isn't a SILVERTOWN, it isn't a CORD"***

**The B. F. Goodrich Co.**

Factories: AKRON, OHIO
Branches and Dealers Everywhere



SEVENTY-FIRST YEAR

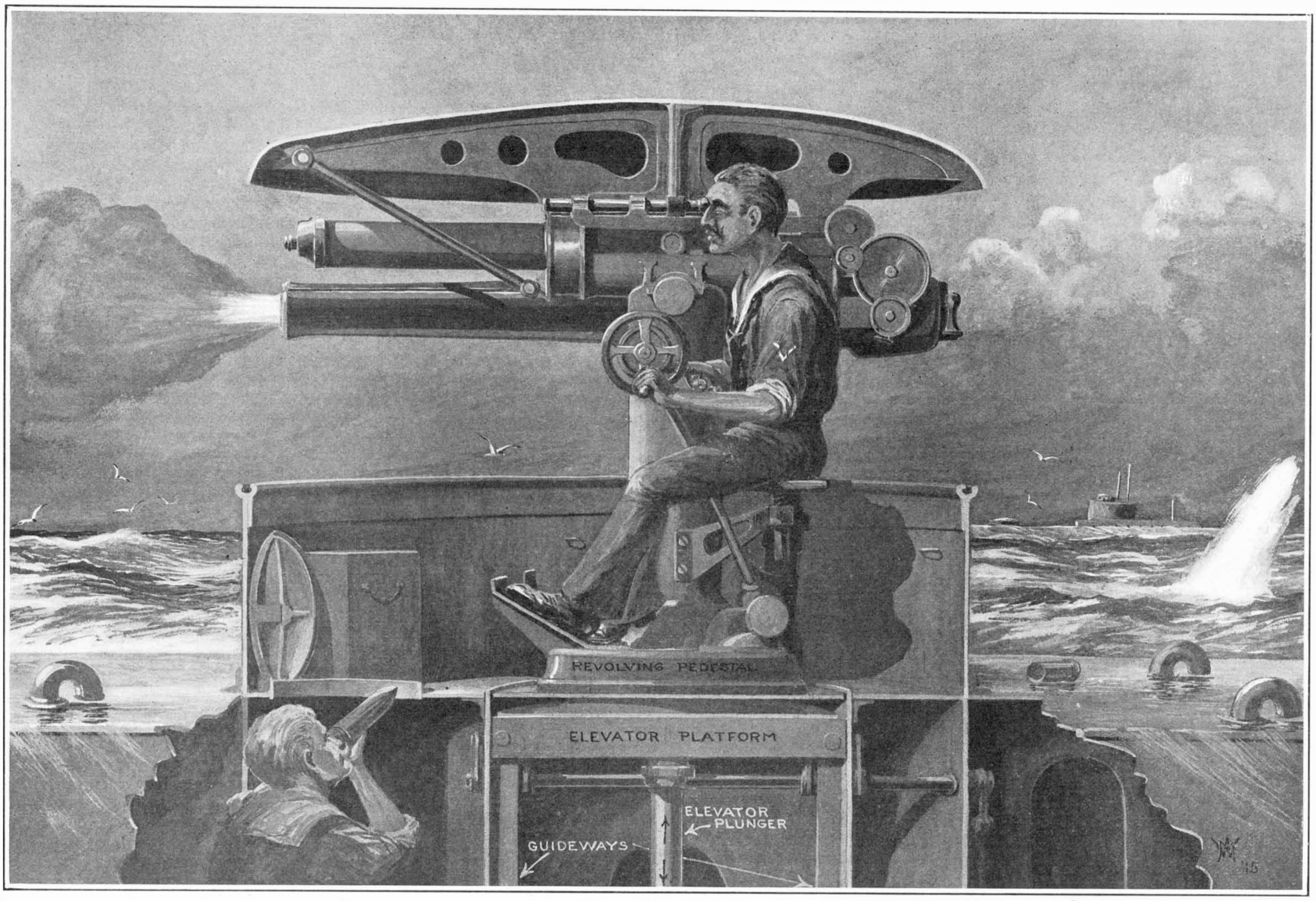
# SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

VOLUME CXII.
NUMBER 18.

NEW YORK, MAY 1, 1915

15 CENTS A COPY
$3.00 A YEAR




**Disappearing guns which it is reported are used on German commerce-destroying submarines.**

## The Submarine as a Commerce Destroyer

THE submarine in the role of a commerce destroyer has proved a surprise to the military world, and the Germans have again scored through their initiative. But it was inevitable that this method of attack would prove too expensive if hits were to be made by the torpedo alone. The merchant craft of the allies were not slow in realizing the limitations of the under-sea boat when relying upon the mechanical fish as a weapon of destruction, and many have been the instances where zigzagging and full speed have made it possible for the ship of trade to dodge the oncoming torpedo.

Latterly, the U-boats have been halting their quarries by means of gunfire and then have blown them up, after abandonment, by dynamite charges planted aboard where they would be likely to sink the merchantmen quickest. But this order of procedure has now become impracticable because of the greater alertness of the flotillas of British and French destroyers. Accordingly, the Germans are now sending the traders to the bottom by gunfire alone in many instances, and this method of attack is far more formidable than has hitherto been believed possible on the part of submarines. Its present climax is extremely significant, for it heralds a new stage in the offensive development of the under-sea boat.

It is a matter of common report that the German submarines that figured prominently in the early months of the war were equipped with two sorts of guns. One a 37-millimeter weapon firing from a fixed pedestal mount a shell of 1½-inch caliber; and the other, a more formidable piece, arranged to disappear into the superstructure and to throw a 12-pound projectile. This gun is a stumpy, but powerful rifle, having a caliber of 2.95 inches, and at moderate range likely to prove an unpleasant antagonist for a torpedo boat. But again this meant exposure for the gun's crew, for the men had to come out upon the deck in plain sight if the submarine were running light, as she would of necessity have to be, to measure forces in this fashion with a surface fighting craft. To get under suddenly, the deck hatch might have to be closed before the men at the gun could retreat into the submarine.

On the 29th of March the "Crown of Castile," a British steamer, was sunk off the Scilly Islands by the German submarine "U-28," and she was sent to the bottom, according to her crew, by shell fire. But this attack, so it is reported, was not made by 12-pound projectiles, but by shell of 4-inch caliber. The 4-inch gun fires a shot weighing in the neighborhood of 33 pounds, and surely this marks an important advance in artillery for submarines. The "Crown of Castile" tried to outdistance her pursuer and to zigzag away from torpedoes, but the German commander not only had superior speed to draw upon, but he had also a surprise in the shape of this newest of under-water-boat guns. Now this development confirms a rumor of recent months that the Kaiser's submarines were being supplied with bigger guns and that these weapons were installed in a novel manner, in fact, so mounted that they would not be continually exposed to the corrosive action of salt water when the craft were running submerged. Further, the arrangement was such that the gun crews did not have to stand upon the open deck.

We are able to illustrate, from a reliable source, the housing, gun and mount, which is said to be identical with that employed by the Germans in their very latest and largest U-boats. It is quite manifest that the installation is a long stride forward in making the submarine more formidable and efficient, especially when used as a commerce destroyer or when called upon to put up a fight against the worst of her present foes, the high-speed sea-going torpedo boats. More than that, the arrangement shelters the gun crews from aerial attack. The particular installation which we are able to show is that for a quick-firing 14-pounder, but the operative principles would be the same for heavier weapons, such as the 4-inch rifles which we are told some of the U-boats now carry.

The gun, with its superposed recoil cylinder and sheltering hood, is mounted upon a revolving pedestal provided with seats for two operators—one controlling lateral movement and the other manipulating the elevating gear with his left hand and firing with his right. The revolving pedestal, in its turn, is supported by a plunger elevator functioned by means of a pneumatic cylinder. The gun-hood is really the hatch cover, and when the weapon is lowered this cover is seated watertight against a rubber gasket in the recess at the top of the hatch or barbette. The gun pointers take their positions when the elevator is lowered, and rise with the rifle when the hatch cover lifts and the gun is cleared for action. The piece can be elevated and lowered in a few seconds.

It is perfectly plain that an installation of this character adds in fact and potentially much to the military powers of a submarine. Because guns of this sort can be worked in the semi-light trim a submarine need not expose so much of her hull or superstructure and, accordingly, should be able just so much quicker to seal up and disappear below the waves for greater security. It is equally evident that a disappearing mount of this nature can be housed beneath and within protecting armor of moderate thickness and a frontal shield set upon the gun, thereby greatly increasing the resistance against attack. In this we can see the first step in an evolutional line which will blaze the way to the still larger sea-going submarine with its upper works in mail.

# SCIENTIFIC AMERICAN

**Founded 1845**

**NEW YORK, SATURDAY, MAY 1, 1915**

Published by Munn & Co., Incorporated. Charles Allen Munn, President; Frederick Converse Beach, Secretary: Orson D. Munn, Treasurer; all at 233 Broadway, New York

Entered at the Post Office of New York, N. Y., as Second Class Matter
Entered as Second Class Matter at the Post Office Department, Canada.





**Subscription Rates**

| | |
|---|---|
| Subscription one year................................. | $3.00 |
| Postage prepaid in United States and possessions. Mexico, Cuba, and Panama | |
| Subscriptions for Foreign Countries, one year, postage prepaid, | 4.50 |
| Subscriptions for Canada, one year, postage prepaid......... | 3.75 |

**The Scientific American Publications**

| | | |
|---|---|---|
| Scientific American (established 1845).......... | per year. | $3.00 |
| Scientific American Supplement established 1876. | " " | 5.00 |
| American Homes and Gardens................ | " " | 3.00 |

The combined subscription rates and rates to foreign countries including Canada, will be furnished upon application.
Remit by postal or express money order, bank draft or check

**Munn & Co., Inc., 233 Broadway, New York**

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp* the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.


*The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.*

## Scientific Solidarity in Wartime

IN the annual report of the United States Weather Bureau for 1897-98 it is recorded, as a noteworthy example of scientific solidarity, that during the war between the United States and Spain the weather forecasters at Washington continued to receive regular meteorological reports by cable from the official Spanish observer at Havana. We cite this episode as an instance in which the spirit of international comity among scientific men (or was it exaggerated Spanish politeness?) appears to have been inconsistent with the demands of patriotism. Presumably the weather reports from Havana aided the American Government in the task of protecting its fleet from the West India hurricanes which might otherwise have proved valuable allies of the Spaniards.

In Europe, during the present war, the interchange of weather observations that prevails in time of peace has been suspended between belligerent countries, while the reports that are still exchanged between friendly countries are withheld from publication until they have ceased to be of more than academic interest. The fact that German meteorologists no longer receive cabled weather reports from the British Isles is said to have been directly responsible for the wreck of the two Zeppelins in Denmark last February.

It is evident that men of science—unless they throw patriotism overboard altogether—must curtail their habitual relations with their colleagues in a hostile country in time of war, but it does not follow that these relations must be completely abandoned, even for the time being; much less that future relations should be embittered by intemperate acts and words during the period of hostilities.

The European war will not last forever. When it is over, intercourse will necessarily be resumed between the scientific men of all the countries now embroiled. There are many scientific enterprises that absolutely depend upon international co-operation, and there is no branch of science in which such co-operation is not helpful. Will not many European *savants* then have cause to regret the gratuitous slurs they are now casting wholesale upon the science of the enemy? This campaign of vituperation has been, in some quarters, as actively carried on as the military and naval operations.

We are glad to learn that a few, at least, of the co-operative scientific undertakings in which the belligerent countries are participators have not been seriously disturbed by this senseless war. The work of the International Latitude Observatories goes on as usual; the German regional bureau of the International Catalogue of Scientific Literature continues to send bibliographic material to the central bureau in London; and the members of the International Commission on Zoological Nomenclature still record their votes as in time of peace.

## Radium as a Fertilizer

A TIMELY bulletin has just been published by the Illinois Agricultural Experiment Station, at Urbana. In it Messrs. Cyril G. Hopkins and Ward H. Sachs report the results of two years' field trials of radioactive substances applied as fertilizers, and also discuss the general question of crop stimulation *versus* soil enrichment.

After reviewing the contradictory results thus far obtained in properly controlled experiments regarding the effects of radium on plant growth—a subject which has already produced a voluminous literature—the writers point out that "efforts are being made to add radioactive substances to the list of commercial fertilizers and stimulants that farmers are urged to buy," thus bringing the subject well within the purview of the State experiment stations, whose activities are not prompted by commercial motives. An analogous situation exists with respect to radioactive waters, the alleged therapeutic virtues of which have received careful attention from the U. S. Public Health Service.

The substantially negative results obtained in the experiments at Urbana will not surprise anyone familiar with previous experiments of the same character as reported in the scientific journals, rather than in the newspapers and the popular magazines. We need not dwell upon this feature of the bulletin, but we think it opportune to record the stand taken by the authors against attempts at crop stimulation in general as an ordinary agricultural practice.

Assuming radioactive fertilizers to be effective and dependable—which apparently they are not—the authors argue that "the effect would be that of a stimulant and the increase in crop yields would be secured at the expense of the soil. Thus the soil would not be enriched in fertility, but actually impoverished by such treatment."

This argument applies also to the still problematical methods of electroculture, and even to the practice of excessive cultivation by means of extra deep tillage, either with subsoil plows or with dynamite.

"Even if such practices were temporarily profitable, they might not be advisable, because they tend to make soils poorer, and the same expense in limestone, phosphate, clover, or manure, which are highly profitable on our common soils, would tend toward positive soil enrichment and permanent preservation of fertility."

This is an important point, and one that has been almost universally overlooked. We believe, however, that there is another side to the question; for there are cases in which the advantages of forcing a crop in order to secure an early yield more than offset the disadvantages of a temporary depletion of the soil. Radioactive fertilizers and electrocultural processes will have their legitimate use whenever they become practical—if they ever do.

## The Beginning of a New Epoch in the Motor Truck Industry

CLOSE observers of the motor truck situation in this country have been noting several tendencies of late which seem to portend an entirely new epoch in this industry—one that seems destined to have a far-reaching effect on the whole system of manufacture, sale, and maintenance of commercial motor vehicles. This change is being brought about entirely through economic causes, apparently, and will do much, it is believed, to offset some of the unsound conditions which have been more or less of a disturbing factor to the best growth of the industry ever since its inception.

To realize fully just what this change is and what its causes are, one must go back and note how the commercial motor vehicle business actually began and how it has developed through its short span of years.

The motor truck industry really had its beginning as a sort of side line to the pleasure car business. The early manufacturers found that there was a demand for light commercial vehicles which they could readily supply by merely fitting their standard chassis with lower gear ratios and putting on special commercial types of bodies. In consequence of this development from the touring car, the same salesmen usually served for both lines, and not until very recent years has the commercial end been thoroughly divorced from the pleasure vehicle line.

Pleasure car salesmen naturally did not probe very deeply into the traffic problems of their prospects. They were chiefly interested in getting sales regardless of whether or not their customers could properly care for and maintain their trucks after purchase. Even with the later system of selling through trained salesmen who make a more careful analysis of each customer's requirements and particular transportation problems, there is still a tendency to "load up" merchants with motor vehicles, who, economically speaking, cannot use or maintain them advantageously. The successful maintenance and use of commercial vehicles calls for skillful handling, proper repairs and upkeep, and careful, systematic management. A thorough observance of these requirements can only be secured by employing competent, skilled drivers and mechanics as well as providing a proper equipment for the maintenance and repairing of the vehicle. Failure to carry out these obligations often makes the otherwise most useful motor truck a veritable "white elephant" on its owner's hands.

Now, in order to successfully meet these necessary qualifications, the small motor truck owner (who has one or two vehicles only) must do one of two things. He must either employ one good driver-mechanic to care for his machine and also own or rent proper garage facilities, or he must pay some garage for its repairs, storage, and maintenance. In either instance his expenses are likely to be considerably out of proportion to the trucking facilities received, for in one case he really maintains equipment and skilled labor sufficient for a much larger number of vehicles than he actually uses, and in the other he must pay regular garage rates with the repairman's profit added.

The question therefore naturally arises, Would it not be better for the small motor truck user, if, instead of attempting to purchase and maintain vehicles of his own, he rent them from a trucking company either regularly or by the trip? Wouldn't he really save money, to say nothing of escaping the worries and troubles of trying to maintain one's own transportation equipment? There are indications that not only the small users but also the manufacturers themselves are beginning to see the light and are rapidly coming to an affirmative conclusion in the matter.

From the manufacturer's standpoint, there is no question but that the present system of marketing commercial vehicles and keeping their owners satisfied is both wasteful and detrimental to the best development of the industry. The very fact that the small truck user will not, because economically he really cannot, properly maintain his vehicles, has forced the manufacturers to provide expensive free repair service, through branches and traveling representatives, at ruinous cost.

The large user can afford to own his trucks outright and properly maintain them because the necessary equipment and skilled labor cost is divided over several vehicles. Therefore, the free inspection and service of the manufacturer was not created primarily for him but for the small user, but he naturally takes advantage of it just the same, to the further discomfiture of the manufacturer. If this expensive feature of the manufacturer were to be cut off entirely, the big user would not give up his trucks, because to him they are not only economically practical, but well-nigh indispensable to his business. The small user is, therefore, the thorn in the flesh that is driving the manufacturer to tackle the problem from another angle, i. e., on the rental basis.

Theoretically, the advantages of the rental system appear very attractive both for the small user and the manufacturer. As far as the former is concerned, he should receive adequate motor-trucking facilities at considerably less cost than at present. His time and attention could be devoted strictly to his business, aside from the regular oversight of his traffic, schedules, routes, etc. He could secure a truck of proper capacity for each particular load instead of, for instance, trying to make a three-ton truck carry a five-ton load, as is likely to be the temptation under the present conditions, and he would be saved a considerable investment in rapidly depreciating equipment.

On the manufacturer's side there should be a lessening of the free service cost, for large centralized trucking companies would be fully as capable of caring for themselves as large private owners. The selling cost would be reduced because of the narrowing of the prospect field. At first, doubtless the more effective use of all vehicles under centralized trucking management might reduce the total sales somewhat, but the lower costs which such a system would make available should bring more customers, and consequently more demand for trucks.

Whether this development along rental lines will come in the form of subsidiary companies or branches of the manufacturers themselves or as separate organizations is of minor importance compared with the sound economic features of the movement in general. That it is destined to play an important part in the future of the motor truck business seems evident, and it would appear to be slowly evolving as a necessary step in the advancement of this important industry toward a firmer and broader foundation.

**Canopus, the Center of the Stellar Universe.**—The last number of *L'Astronomie* is chiefly devoted to the subject of "the giant sun Canopus." Though somewhat less bright than Sirius, on account of its vastly greater distance from us, Canopus is much the larger star. Its volume is supposed to be 2,420,000 times that of the sun, and its brilliancy 49,700 times. Walkey's computations seem to show that Canopus actually occupies a central position in the stellar universe, as we know it. The sun is credited with a distance of 489 light-years from this central luminary, around which it is said to describe an orbit the plane of which is inclined at an angle of 20 degrees to the plane of the galaxy. The sun's last periastron passage is stated to have occurred 6,950,000 years ago. The whole subject is, of course, highly speculative.

## Electricity

**Albert Medal Awarded to Marconi.**—The Albert Medal of the Royal Society of Arts, England, which is awarded annually for distinguished merit for promoting arts, manufactures, and commerce, was presented to Guglielmo Marconi this year. The medal was instituted in 1863 when the Prince Consort was president of the society.

**Electric Drive in a Paper Mill.**—A paper mill at Maumee, Ohio, reports a saving of $400 a month as a result of the introduction of electric drive. Previously this mill operated with steam power, using two 100-horse-power boilers. Now in place of being driven from long lines of shafting, the machines are individually driven by motors. Not only has this resulted in a direct saving of power, but it has been found possible to reduce by two men the regular force of workmen.

**A New Alternating Current Fan** has made its appearance in which variation of speed is obtained not by means of a rheostat, but by rotating the windings of the fan. The advantage of this is that the fan may be started at any position of the winding without danger of burning out by merely operating a push button. The energy that is consumed by the fan varies with its speed, which is not the case with the ordinary fan. When this fan is operating at full speed it takes 24 watts, and at the lower speed, it consumes about 7 watts.

**Electric Air Brake.**—Electric-pneumatic brakes are soon to displace the air brakes used on the passenger trains of the Pennsylvania Railroad. This form of brake has been found necessary because of the weight of trains made up of all-steel cars. In long trains the shock and surging accompanying the application of the brakes has proved very objectionable indeed. In a twelve-car train it takes eight seconds for the full braking force to be felt at the last car. With the electro-pneumatic brake, the braking power will be exerted at the same instant on all the cars, and within two seconds after the application of the brakes, the whole braking force will be exerted throughout the train.

**Lamp Trimmers' Safety Signal.**—Arc lamp trimmers frequently find it difficult to lower the arc lamp on a busy street without the danger of having the lamp crashed into by passing vehicles. The driver of a car is more apt to keep his eyes on the road than to look up, and sometimes the glare of the sun will prevent him from seeing a lamp that is hanging just high enough for his vehicle to hit it. Realizing this danger, a man in Minneapolis has devised a signal consisting of a tripod with two white signal wings on which red circles are painted. This the lamp trimmer places on the street under his lamp, and then he may lower the lamp without fear of a collision.

**Cell Which Reverses Polarity When Illuminated.**—In a paper read before the British Physical Society, Mr. A. A. Campbell Swinton describes a curious phenomenon in a galvanic cell having for one electrode a plate of zinc and for the other tinned copper, coated on one side with selenium and varnished with enamel over the remainder of its surface. When these plates are immersed in tap-water the galvanometer shows that in the dark the zinc is electro-positive to the selenium, but when light falls on the selenium the polarity is reversed. If in place of the zinc plate, a plate of carbon or copper is employed, then the selenium proves to be electro-positive in the dark and electro-negative when illuminated.

**Edison Batteries for Submarines.**—The disabling of the submarine "F-4" in Honolulu Harbor, the cause of which at present writing has not been ascertained, has led to the surmise that some trouble might have been experienced with the batteries. Should sea water have come into contact with the sulphuric acid of the batteries, chlorine gas would have been generated. Of course sulphuric acid is not the only electrolyte that need be used in storage batteries. The Edison battery, for instance, uses a potash solution which gives off no poisonous gases when coming into contact with sea water. Public interest in the Edison cell has been aroused particularly by the fact that the new submarine "L-8," which was recently launched, is equipped with this type of battery.

**Tiny Motor for Dentists' Use.**—An electric motor, even in small sizes, is quite heavy for the power it yields. For this reason dentists have been using a motor mounted on a bracket, and connected by a flexible shaft with the point of application of the power. Recently, however, a miniature electric motor has been devised for the dentist's use which is so small and weighs so little that it may be connected directly to the dental chucks and used as a hand tool, thus doing away with the cumbersome universal shaft. In place of the shaft a light electric cord connects the motor with a lamp socket. The motor is one of the smallest ever made for commercial use. Its weight is but 5¼ ounces, and it is 1¾ inches long by 1¼ inches in diameter. It uses only 12 watts and operates at a speed of 15,000 revolutions per minute. It can be used either on direct or on alternating current. A control switch is mounted on the motor where it can be operated conveniently by the hand. The speed of the motor may be controlled by a foot-operated rheostat.

## Science

**The Non-magnetic Yacht "Carnegie"** started March 6th on her fourth cruise, which is expected to continue for two years. During the period November, 1915-March, 1916, an attempt will be made to circumnavigate the globe between parallels 60 and 65 degrees south latitude.

**Sven Hedin**, the distinguished Swedish explorer, has been excluded from honorary membership in the Royal Geographical Society and from the Russian Imperial Geographical Society, on account of his pro-German attitude in connection with the war. Both bodies will probably be heartily ashamed of themselves after peace is declared. Patriotism and science should not interfere with one another.

**Is Arsenical Spraying Dangerous to Birds?**—It has been commonly reported that arsenical spraying of trees in New England in order to eliminate the gipsy moth has proved fatal to many birds, but according to Dr. L. O. Howard, Chief of the U. S. Bureau of Entomology, investigations fail to show any such result. The absence of birds from the regions where spraying has been practised can be explained by the fact that the spraying causes a scarcity of insect food, and the birds are obliged to seek this elsewhere.

**A Travel Course in Physiography** is an interesting item in the programme of the forthcoming summer session of Columbia University. This course will take the form of a physiographic excursion to the western United States, conducted by Prof. D. W. Johnson, lasting about two months. The party will visit the Devil's Tower, Yellowstone National Park, Glacier National Park, Crater Lake, the Yosemite Valley, Royal Gorge of the Arkansas, the Pike's Peak region, and probably also Lassen Peak and the Lake Bonneville region. The start is to be made from New York in July.

**Modern Piano Wire.**—Supplanting the hard, high-tension strand of old, the piano wire in demand to-day for the highest grade instruments is tough and fibrous and of absolute uniformity, and when cut, it shows a clean, white steel. The piano makers have, by actual test, been brought to see that the softer wire has the greater artistic merit. The latter vibrates so evenly throughout, when actuated by the proper degree of energy, that a true fundamental tone results, with just enough of the octave to impart brilliancy, of the fifth to impart timbre and of the third and sixth to impart richness, and will be amplified by the sounding board.

**The Rediscovery of "Nephritic Wood."**—Mr. W. E. Safford recently addressed the Botanical Society of Washington on this subject. "Lignum nephriticum," or "nephritic wood," so called on account of its supposed medicinal properties, was obtained from Mexico and widely used in Europe in the sixteenth, seventeenth and early eighteenth centuries. It is constantly mentioned in the scientific literature of those centuries. An infusion of the wood in water produces remarkable fluorescence, and this phenomenon was observed by the Hon. Robert Boyle in the seventeenth century. In modern times this wood has been nearly forgotten; scarcely a fragment of it is now to be found in drug collections, and its botanical identity has hitherto been altogether uncertain. It is now identified as *Eysenhardtia polystachya* (Ortega) Safford. Mr. Safford exhibited specimens of the wood and botanical material, and Dr. Briggs, of the Bureau of Plant Industry, showed the fluorescence of its extract in the rays of an arc light.

**Agricultural Atlases of the United States.**—A notable undertaking of the Office of Farm Management, U. S. Bureau of Plant Industry, is a large agricultural atlas of the United States, to which several other branches of the Department will contribute. This work will be published, in the first place, in the form of a number of separate monographs, which will ultimately be combined to form the complete atlas. Pending the completion of the large work, a similar work on a much smaller scale, adapted for use as a school atlas of American agriculture, will be issued—probably this year. This will comprise about 100 pages of maps and diagrams, accompanied by a brief text. The maps will present the following subjects: Relief; soils; climate; crops (distribution, seed-time and harvest, etc.); live stock distribution; size, value and tenure of farms; rural population.

**Public Education and Cancer.**—The campaign for public education which is now being undertaken by the American Society for the Control of Cancer should be productive of good results if the experience of Germany is any criterion. The campaign originally initiated in eastern Prussia by Winter of Koenigsberg for the instruction of all people, but particularly of women, in the early symptoms of cancer explained the value of the earliest possible surgical and medical treatment. In this campaign the co-operation of the laity and the medical profession on the one hand and the press on the other was enlisted with excellent results. When the campaign was started in the early nineties the cancer death rate of Koenigsberg had increased from 53 in 1880 to 110 in 1893. The rate continued to increase up to 1907, when it reached a maximum of 139 per 100,000 of the population. Subsequent to that year the rate gradually declined to a minimum point of 118 for the year 1912.

## Aeronautics

**Invisible Aeroplanes.**—Of late there have been made attempts to construct aeroplanes of a transparent material, at least for all purposes where a canvas covering is used at present, such as the wings and the fuselage. One of the latest ideas of the kind is said to be an aeroplane which uses un-inflammable celluloid for the wings and other parts, and when flying at a few hundred feet in the air the apparatus is quite invisible, according to reports. A new muffling box on the motor serves to deaden the sound. One advantage of the transparence is that observations can be made in all directions.

**A Reaction Helicopter.**—A patent has been granted to Alphonse Papin and Didier Rouilly of Paris, France, No. 1,133,660, for a Helicopter, the improvement being applicable to all helicopter machines. In the improved helicopter the propulsion is effected by the reaction obtained from jets of air blown into the atmosphere through orifices or nozzles in the helicopter, on the principle of the aeolipile, the single propeller or screw of the helicopter having hollow blades or wings and the screw carrying blower means to propel air through the hollow wings and out of the orifices.

**Three Aeroplanes for the Navy.**—It has been announced that the Secretary of the Navy is about to place an order for three hydro-aeroplanes with the Burgess Company, of Marblehead, Mass., at a contract price of $11,500 each. Bids had been asked for the furnishing of three or six machines, the award to be based on the completeness of the proposals, and the extent to which the designs conformed to or exceeded the requirements, and owing to the character of the bids it was decided to contract for only three machines at this time. This is the first contract placed since Congress appropriated $1,000 for aviation.

**Panhard-Levassor Aviation Motor.**—The new 100 horse-power type belongs to the class of light water-cooled motors, and its lightness is secured by a judicious grouping of the parts rather than by an exaggerated lightening of the pieces. The V-shape is here adopted, and there are two sets of 4 cylinders mounted on the crankcase at a 90 degree angle. Water cooling, which is common to each set of 4 cylinders, is noteworthy by the adoption of longitudinal cooling wings upon the water jacket, on the outer side, while the valves all lie on the inner side or next the top of the motor, being driven by a single cam shaft. Bore 4.4 inch by 5.6 inch stroke; speed 1,500 revolutions per minute; weight 440 pounds, which gives the weight per horse-power as 4.4 pounds.

**Firing Between Propeller Blades.**—A year ago—on April 11th, 1914—the SCIENTIFIC AMERICAN illustrated a machine gun firing over the tractor screw on a monoplane. A German patent has recently been issued describing a means of shooting through the disk area of a propeller. The trigger of the gun is geared to the engine so that when a blade is in the line of fire a lock prevents the gun from being operated. Roland Garros is said to have chased and brought down two Tauben recently by firing between his propeller blades. The difficulty of the operation may be judged by the fact that the normal speed of a Gnôme motor is 1,200 revolutions per minute. The builder of the Heinrich biplane also proposes to arm the machine with a gun firing between the blades of the tractor screw.

**Two Hundred Horse-power Anzani Motor.**—The latest Anzani motor is one of the most powerful that is in use for aeroplane work. It has 20 cylinders grouped around a circular crankcase, cylinder bore 4.2 inch and stroke 5.8 inch. Speed is 1,250 revolutions per minute. On this type there are used 4 groups of 5 cylinders, all cylinders being of the same size. On the barrel-shaped crankcase each group is spaced along so that the cylinders are staggered with reference to the other groups, but viewed from the front, the effect is a star with 10 fore cylinders and 10 rear cylinders, while the side view shows each of the four groups lying in a somewhat different plane. Two cranks are used on the shaft, No. 1 being operated by all the rods of 10 cylinders and No. 2 by the remainder. Weight of the Anzani motor is 682 pounds.

**Stabilizing Apparatus for Flying Machine.**—An automatic stabilizing apparatus, particularly of that class in which a pendulum is provided is shown in a patent No. 1,132,503, to O. Wittokowski of Dusseldorf, Germany, the object being to provide an apparatus which will not be injuriously affected by the inertia of the pendulum when the flying machine changes its velocity. In doing this the pendulum, which is designed for stabilizing the flying machine in a longitudinal direction, is provided with a plane or planes which have a rocking support on a transverse axis and are so connected with the body of the flying machine that they are set, when the body is inclined at a certain angle, at a corresponding angle in order that in each position of the body the forces acting on the same are at an equilibrium, such forces being the pull of the propeller and the resistance of the front faces of the body of the machine and the pendulum. Thus in operation the air resistance of the pendulum is varied according to the inclination of the body to the direction of flight.

# The European Infantryman's Rifle

## Comparison of Mausers, Mannlichers, Lee-Enfields, and Other Weapons Used in the War

By Edward C. Crossman

**On the Whole the Great Military Powers Agree in the Demands They Make of the Service Rifle. England Seems to be the Worst Off, Because Her Troops Are Not Uniformly Armed**

**As Might be Expected the German Mauser is the Best Service Rifle Now in the Field. It has Been Adopted by Other Fighting Nations, Notably Belgium, Turkey, and Russia**

THE British were caught in bad shape when the war broke out. They have clung to the old Lee action, taken up in 1889, and with many changes have used it ever since despite its weakness and the advent of better rifles. Evidently the hope of an automatic military rifle prevented them from disarming their troops of the old Lee and re-arming them with a better rifle, like the Ross or Mauser.

They now use the short Lee-Enfield in the regular army which is now on the Continent, a rifle using chargers of five cartridges something like the clip of the Mauser, for refilling the Mauser magazine. Only the British rifle, having a protruding box magazine, holds ten cartridges or two clips at a time, against the five of nearly all other rifles like the Mauser and its American brother, the new Springfield, a Mauser with some changes.

Unhappily the territorials, or "militia," as we would call them, have the older long rifle, giving different shooting, and of course a nuisance were two forces of the two branches fighting on the same line. Both rifles are inferior in strength and simplicity to the Mauser. The British had an experimental rifle finished and a few ready for experimental issue when the war broke—a Mauser firing the 0.280 cartridge much like the Ross. Of course, it cannot be used, not being beyond the experimental stage.

**The British Mix Their Rifles and Ammunition.**

Worse still, the British have a mixed lot of ammunition, and this might cause bad mixups in giving sight settings and calculating the fire of troops. The regulars on the Continent are using the Mark VII, a spitzer of 174 grains loaded into the same old 0.303 case, but giving 2,440 foot-seconds instead of 2,000, as did the old Mark VI, with blunt nose 215-grain bullet. This Mark VII is a fair cartridge, but there is not enough of it, and the British must fall back upon the Mark VI old style stuff, giving lower velocity; and worse than this, to be shot in rifles sighted and with sights graduated for the newer ammunition.

Take, for example, a regiment of the line, armed like the others with the short Lee, but supplied in the rush of a hot attack with the Mark VI or old ammunition. If the officers giving range and sight settings did not know and remember this and give a far higher sight setting to compensate for the lower speed of the old style stuff, the entire fire of this regiment would be wasted, because the bullets would strike the ground short of the mark. Mixed ammunition, like mixed rifles, is a frightfully bad thing in hard fighting.

The Mark VII is loaded with 40 grains of tubular cordite powder, a yellow, celluloid-like stuff that comes in tubes or sticks just the length of the shell space behind the bullet. A bundle of the sticks is pushed into the cartridge, then the neck is formed by machinery and the bullet seated in this neck.

The British have bought a huge number of the Japanese service rifle, a modified Mauser manufactured in Japanese arsenals, but fear to send them to the Continent because of the great complications they would add to the already hard problem of supplying the right ammunition for the various types of rifles their troops already are using. Unless a complete unit, such as a division, can be armed with these rifles, sending them over would merely add trouble. The Japanese rifle is 0.25 caliber; the British rifle is a 0.303.

Very evidently the British have been badly blistered by the work of the despised German sharpshooters, and they lay most of the efficiency of these men to their telescopic rifle sights.

A number of men in every German company of infantry are supplied with the fine prismatic telescopic rifle sights, and with these to aid them in picking up, and aligning the rifles upon almost hidden foes, they do murderous work in their sniping.

The British have finally resolved to meet them at their own game, and have placed large orders in America for telescopic rifle sights, depending mostly upon the makers of the telescope sight for the American army. In our own service the two best shots in each company of infantry are armed with rifles equipped with fine prismatic telescope sights, for just this sniping work.

On a well-lighted and defined objective, the telescope rifle sight offers no advantage to the man with normal eyesight, but in picking out a partly hidden or badly lighted mark, the telescope sight gives the rifleman the same advantage that a fine prismatic field glass gives the person using it. It is necessary merely to find the mark in the field of the glass, touch it with the needle point in the telescope field and squeeze the trigger.

The telescope mounted on the American service rifle, although not yet perfect, is probably the most carefully designed telescopic sight ever made. Short and compact, it is furnished with graduated elevating and traversing disks for the finest adjustments in range and windage. No other instrument of its sort approaches it, save the sighting telescopes used on field guns. Optically, it is hardly the equal of the German glasses.

**The French "Lebel"—An Amusing Rifle.**

The French use a rifle, the Lebel, that looks like the old wrecks sold in department and army sale stores, and labeled Veterli or something similar to it. It has a tubular magazine in the forestock like an American repeating rifle, the receiver is nickel-plated, and, all in all, it is the most amusing looking rifle of the whole collection. Its whole get-up looks crude and child-like. Add to this a fearfully long triangular bayonet, such as the American army discarded twenty years ago, give the soldier carrying it a long blue coat like an overcoat and a pair of red trousers, and you've got a picture to make the gods weak from laughter.

The cartridge is quite interesting, with its solid copper-zinc alloy bullet. Not satisfied with the virtues of the sharp point, the French went still farther, and put on a tapering stern on their bullet; so it is a true boat-shaped bullet, instead of being cut off square behind like all other bullets. Thus, the bullet is given a streamline form, which even German ballistic experts admit cuts down air resistance. It weighs 170 grains and it leaves the rifle with a speed of 2,400 foot-seconds. It is quite as good as the English cartridge. The magazine is loaded, not with clips or chargers like the rifles of the others, but by the slow process of cramming in one shell after another into a tubular magazine like an American Winchester's.

**The Russians and Their Modified Mauser.**

The Russians use a modified Mauser, with ammunition of the old blunt nose type like the British Mark VI, velocity 2,000 foot-seconds. The bayonet, a triangular one, is always fixed, is very hard to remove, and has no scabbard. It is carried on the rifle at all times—a very clumsy, crude and senseless scheme.

The Belgians use the Mauser, with ammunition of the older blunt nose type, clip-loading, like the rifles of all the nations save France. In this system a clip or charger of five cartridges is pushed into a slot at the top of the magazine entrance. A push of the thumb drives all five out of the clip, down into the magazine, and the clip is thrown away. The caliber, like that of the Russian and French rifles, is practically 0.30.

The Turks use the Mauser, of 0.30 caliber, and use to some extent the newer pointed bullets in this rifle.

The Austrians and the Germans are the best equipped of any of the nations in the rifle line. The Austrians use the Mannlicher, firing pointed bullets with a velocity of nearly 2,800 foot-seconds.

**The New German Mauser—The Best in Europe.**

The Germans use the latest type of Mauser, from which the American new Springfield was taken. The rifle, a clip-loader, weighs nine pounds. It fires spitzer bullets of 154 grains weight, with a velocity of over 2,900 foot-seconds. The rifle in its simple sight-setting arrangement, its finish, its accuracy, and the high speed of its bullet is superior to the rifle of any other nation among those fighting. It has a long sword bayonet, usually carried in a scabbard at the soldier's belt. With its long barrel and long bayonet, it gives a stabbing length of 5 feet 9 inches with the bayonet on, beating the others save the long bayonet of the Frenchman.

The German soldier has eight inches the better of the argument over the British soldier when it comes to crossing bayonets, and the extra eight inches easily turns the battle in favor of the longer, if both men are of equal skill.

The Japanese, in true Japanese style, a people who lift everything they fancy and make it without regard to the laws of patents or copyright, make a rifle that is a Mauser in the points that are good, terming it "Year 38." It fires a 0.25 caliber cartridge, with pointed bullet and a velocity of 2,900 foot-seconds.

The Canadians, in spite of being part of the forces of the British Empire, cast out the ancient and honorable Lee nearly ten years ago, taking the Ross, a rifle made by Sir Charles Ross of Scotland, in Quebec. Their present rifle, practically the rifle that sells on the American market for sporting use, fires the regulation 0.303 British army cartridge instead of the much better Ross product, the 0.280. This, of course, because of the necessity for using the same cartridge as the British troops.

This Ross is a straight pull rifle; that is, by an arrangement primarily like the familiar spiral screw-driver, the bolt with the locking lugs is revolved by pulling straight back on a bolt handle and separate sleeve, unlocking the bolt without the usual half turn of a bolt handle, as on the Mauser, Krag, new Springfield, and Lee-Enfield.

**The Rifles of Austria, Bulgaria and Greece.**

The same principle is used in the Mannlicher straight pull of Austria, Bulgaria, and Greece. This type of rifle action is very fast, a snap back and forth of the wrist being sufficient to operate it, but it is more tiring for a long series of shots because of throwing the strain on only one set of muscles.

All the other rifles use what is called the turn-bolt, a long cylindrical bolt containing striker and main spring, carrying an extractor on the head, and having two steel lugs to lock against the explosion, working back and forth in grooves cut in the receiver. The bolt is locked by turning it a quarter round to the right, revolving the lugs in behind shoulders in the frame; it is unlocked in the reverse direction, hence the name turn-bolt, as opposed to the straight pull rifles of Austria, Greece, Bulgaria, Switzerland, and Canada. The chief virtues of these rifles is the strength, the simplicity, and the impossibility of jamming the mechanism for more than a moment. All the essential parts can be removed for cleaning and repairs without tools.

This is true in the highest degree with the German Mauser, in the lowest with the French Lebel and the straight pull Mannlichers.

With these magazine rifles, fitted with magazines for charger loading, and having a wonderfully high rate of sustained fire, the problem is to keep the men supplied with ammunition for an all-day's hot battle. The Japanese troops went into some of the battles near the Yalu and later, carrying 350 rounds of ammunition per man. Yet some of the soldiers were out of cartridges by noon. The weight of 350 rounds of the Japanese 0.256 cartridge is, of course, 350 times the weight of each cartridge, this being 350 grains. Each soldier was therefore carrying, besides his regular pack and rifle, 17½ pounds of cartridges.

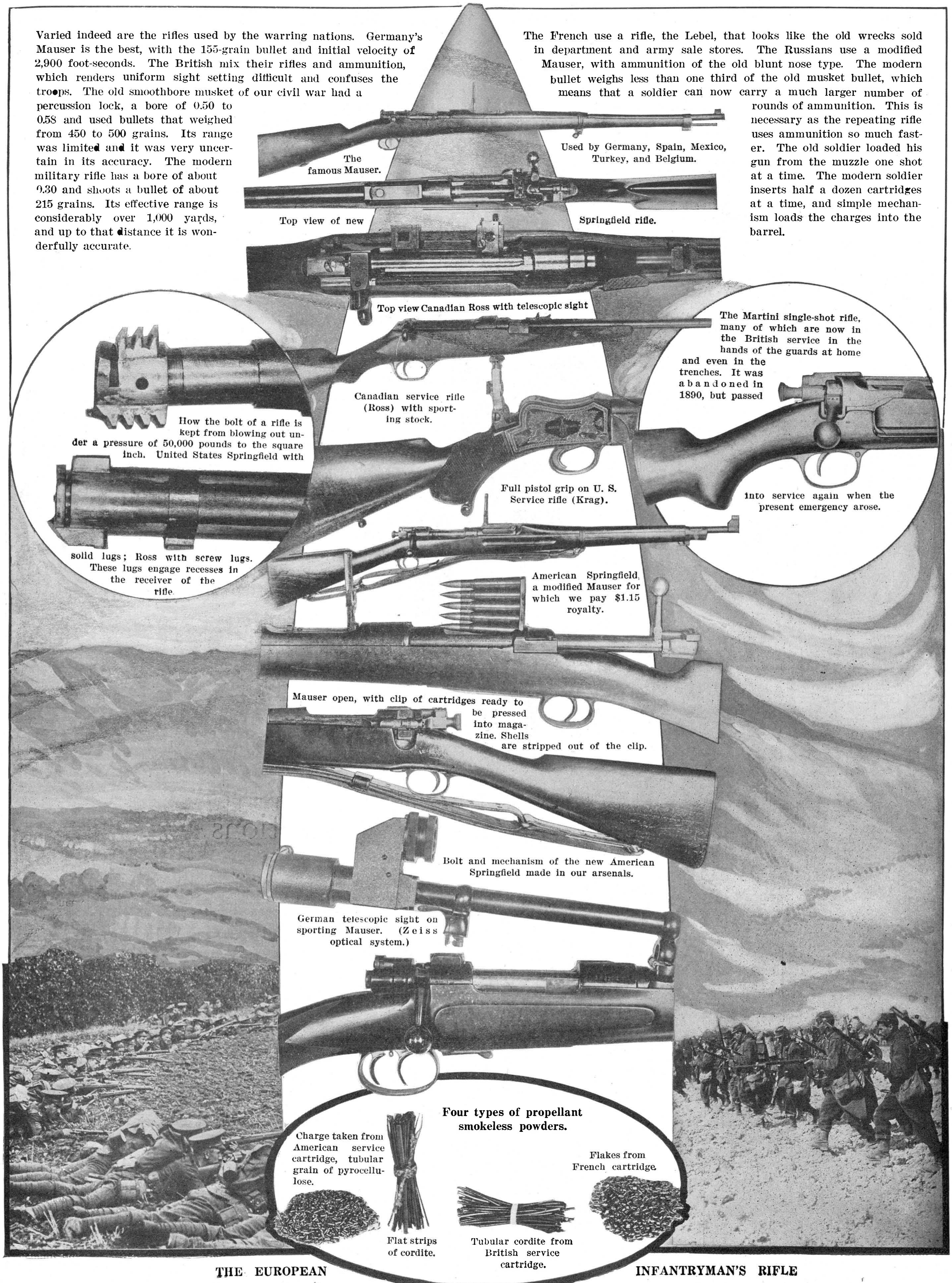
The British soldier, carrying as much, is still worse loaded down, because of the greater weight of his ammunition. Using the old type of Mark VI, to which he is probably reduced by this time, he lugs nearly 21 pounds if he takes in 350 rounds. With hasty trenches thrown within 400 yards of each other, as reported in one phase of the British fighting, there is very little time to replenish the supply on the firing line from the reserve store as is laid down by all good text books.

# The Rifles of European Fighters

## They Have a Range of 4,200 to 5,200 Yards, But That Is Not Their Chief Virtue. They Shoot Flat, Thanks to Their Sharp-Pointed Bullets, and Flatness of Trajectory Counts for More Than Range in Shooting

Varied indeed are the rifles used by the warring nations. Germany's Mauser is the best, with the 155-grain bullet and initial velocity of 2,900 foot-seconds. The British mix their rifles and ammunition, which renders uniform sight setting difficult and confuses the troops. The old smoothbore musket of our civil war had a percussion lock, a bore of 0.50 to 0.58 and used bullets that weighed from 450 to 500 grains. Its range was limited and it was very uncertain in its accuracy. The modern military rifle has a bore of about 0.30 and shoots a bullet of about 215 grains. Its effective range is considerably over 1,000 yards, and up to that distance it is wonderfully accurate.

The French use a rifle, the Lebel, that looks like the old wrecks sold in department and army sale stores. The Russians use a modified Mauser, with ammunition of the old blunt nose type. The modern bullet weighs less than one third of the old musket bullet, which means that a soldier can now carry a much larger number of rounds of ammunition. This is necessary as the repeating rifle uses ammunition so much faster. The old soldier loaded his gun from the muzzle one shot at a time. The modern soldier inserts half a dozen cartridges at a time, and simple mechanism loads the charges into the barrel.



The famous Mauser. Used by Germany, Spain, Mexico, Turkey, and Belgium.

Top view of new Springfield rifle.

Top view Canadian Ross with telescopic sight

How the bolt of a rifle is kept from blowing out under a pressure of 50,000 pounds to the square inch. United States Springfield with solid lugs; Ross with screw lugs. These lugs engage recesses in the receiver of the rifle.

Canadian service rifle (Ross) with sporting stock.

The Martini single-shot rifle, many of which are now in the British service in the hands of the guards at home and even in the trenches. It was abandoned in 1890, but passed into service again when the present emergency arose.

Full pistol grip on U. S. Service rifle (Krag).

American Springfield, a modified Mauser for which we pay $1.15 royalty.

Mauser open, with clip of cartridges ready to be pressed into magazine. Shells are stripped out of the clip.

Bolt and mechanism of the new American Springfield made in our arsenals.

German telescopic sight on sporting Mauser. (Zeiss optical system.)

Four types of propellant smokeless powders.

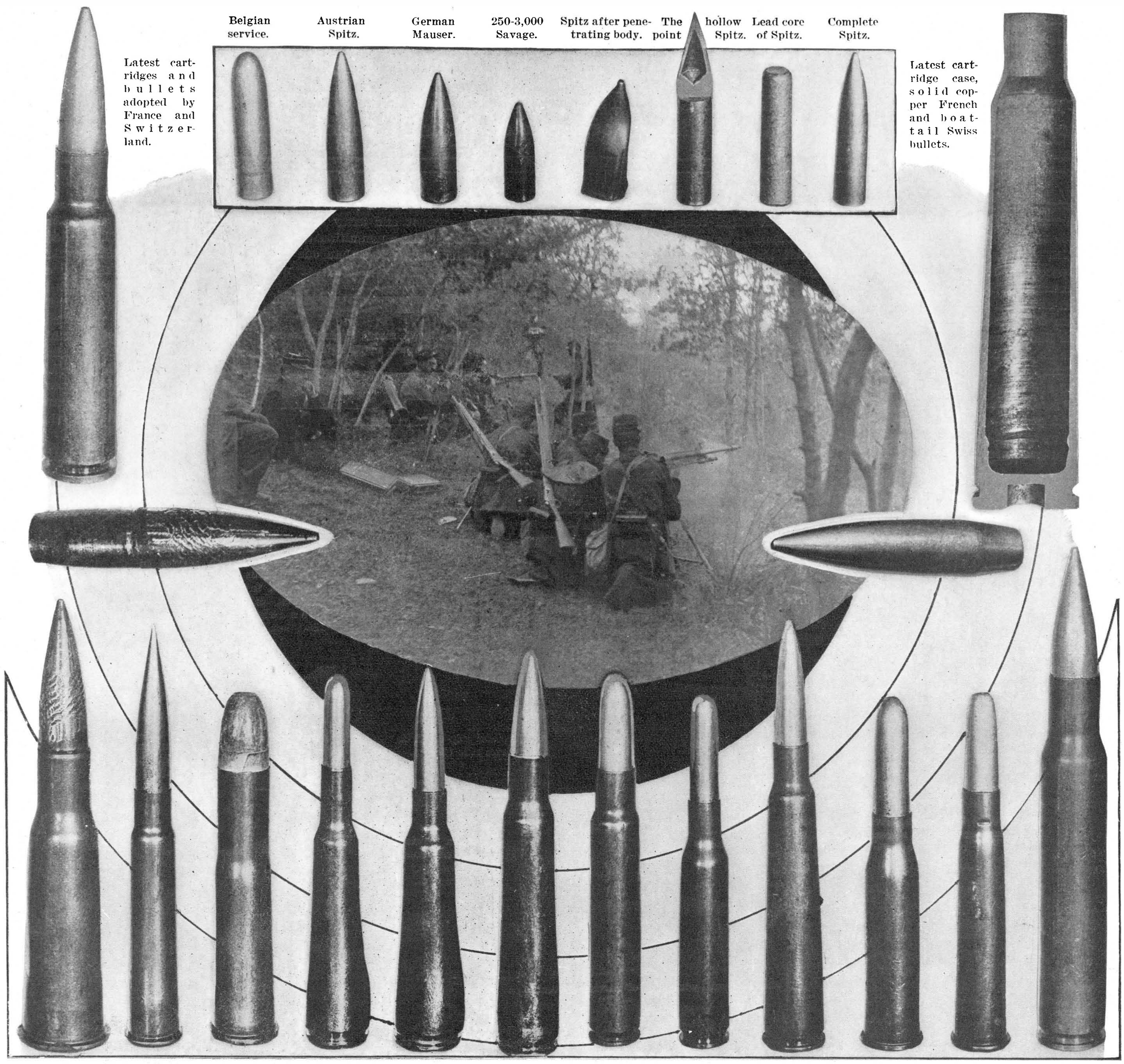
Charge taken from American service cartridge, tubular grain of pyrocellulose.

Flat strips of cordite.

Tubular cordite from British service cartridge.

Flakes from French cartridge.

THE EUROPEAN INFANTRYMAN'S RIFLE




French service cartridge. | Extreme target Spitz. | Single shot Landsturm. | Greek-Italian 25-caliber. | Japanese 25-caliber. | United States new Springfield. | Belgian service. | Portuguese 25-caliber. | Ross 280-caliber. | Bulgarian service. | British Mark IV. | U. S. Spitz used by White.

# The Bullets of the Fighting Nations

## How the Shape of a Bullet Affects Its Flight

BACK in 1905 the Germans, prying around, as usual, in rifle experiments, re-discovered the ballistic fact that if you sharpen the bow of a bullet it cuts down air resistance, as sharpening the bow of a canal boat to a yacht bow cuts down the resistance of the water. Back in the 50's Col. Jacobs, a British officer stationed in India, had discovered this, had proved it, and had called the attention of the world to the fact. For a half century mathematical gentlemen, such as Bashford, had laid down the law that the point of a bullet made no difference in the flight of a bullet. It does make little difference in the ultimate range, but this is not considered in designing a fighting rifle.

The Germans found that so much did a sharpened point cut down the terrific resistance of the air, that they could shave down their army bullet from 215 grains to 154 grains and still overcome air resistance, and retain the same proportion of the original speed imparted by the rifle as with the old heavy bullet.

This meant, in turn, that they would greatly increase the velocity—the speed—of the bullet, which, in turn, meant that the flight of the bullet would be much flatter, and *ergo*, over fighting ranges, the chances of hitting men anywhere along the field were much increased. Errors in judging range were much less costly, because the bullet did not rise high enough to miss, anyhow. Setting sights or changing sights for changes in range were obviated, because so flat flew the new bullet that for 500 yards or more a man kneeling would be hit anywhere from the muzzle to the 500-yard mark were the rifle sighted for 500 yards.

In other words, the new cartridge—the "S" bullet, it is called by the Germans—gave a danger space of more than 500 yards—500 yards of space from the muzzle of the rifle over which the bullet nowhere got up high enough to go over a kneeling man. This is the result of a flat trajectory or bullet flight, and this in turn comes from a high muzzle velocity, and this in turn can be had only from a light bullet. And light bullets are of no use if they fall off quickly from air resistance, and only the sharp point confers comparative immunity from this terrific resistance through which the bullet has to force its way.

Such is the reason for the sharp point bullet used by the Germans, the French, the Austrians, the British, the Canadians, and probably the Russians to some extent. The Germans termed it a "*Spitzgeschoss*," merely a pointed bullet. It is sometimes termed a "spitz" bullet, with a queer hybrid of German and English in the term, and English-speaking people usually term it a "spitzer," a sort of slangy corruption of the original word. But it is not a "spit ball," our San Francisco friends to the contrary notwithstanding.

The bullet is pointed, not unlike a neatly sharpened lead pencil. It looks quite merciful, so much so that up rose multitudinous fools about the country with the announcement that this bullet was adopted because of its humane disposition.

The United States promptly took it up, calling in its new rifles, the new Springfield, and rechambering the barrels to fire the new ball. The change in this rifle threw out the old blunt nose bullet of 220 grains and with a muzzle speed of 2,200 foot-seconds and substituted a spitzer of 150 grains with a velocity of 2,700 foot-seconds.

The extreme range of the two sorts of bullets is 5,200 yards for the present spitzer, 4,200 yards for the old blunt nose bullet used in the Springfield.

But let me pause here and spear a fallacy common among the uninformed. The extreme range of a rifle—the distance to which it will carry when pointed at an angle of 45 degrees from the horizontal—has absolutely no bearing on its virtues. It is a by-product, not a virtue, not sought for by rifle designers, not cared for by military men, and absolutely not considered. The ballistician in military walks of life cares not a whoop whether the bullet finally winds up 4,200 yards or 4,200 rods from the muzzle if the rifle is fired at an angle of 45. A rifle is no more to be judged by its extreme range than a horse is to be judged by the number of hairs in his eyebrow. Extreme range, we have said, is a

by-product; nobody cares what it is, because it is not used, nor is half of it ever used.

Promise a fighting man a rifle that had a danger space of 1,000 yards but the bullet of which faded into thin air at 1,500, and he'd fall on your neck and call you brother, and probably try to pick your pockets of the plans of the new weapon. Fifteen hundred yards is extreme range for the military rifle in actual use, but very uncommon. A thousand yards sometimes sees the ball open, but often the fighting hardly begins at this distance.

The thing for which all ballisticians strive is a rifle that shoots very flat over fighting ranges which lie under 1,000 yards, to obviate sight changes, and to minimize the cost of errors in range judgment. After that the range of the bullet can go hang; infantry fire is not even remotely effective—worth the ammunition—at ranges half as far as the rifle would carry. Therefore, the surest way to prove that you don't know the first principles of the military rifle is to begin to talk about its range. The two favorite questions of the proletariat —"How many does she hold? How far will she shoot?" The man that knows what is needed asks, "How fast can the magazine be recharged? How flat does she shoot?"

Now, the harmless little sharp point bullet, that promised to ooze through parties on the other side of the argument so gently that they would hardly mind it, turned out to be a little devil. Its evil disposition varies with the rifles in which it is used, due probably to difference of balance of bullet, etc.

In the American Springfield it does just the opposite to what it promises. Because the weight is far back, because of its high speed, and because it is very easily upset, it proceeds to spin widely on its tail when it hits tissue, if not to travel sideways like a hog to battle.

It rips and slashes and knocks things out of time by the shock it imparts. Once in a long while it behaves like a civilized bullet, but not often. It is very freakish in its travel. Stewart Edward White records one bullet that struck a beast in the right shoulder, went through to the left, broke it, traveled down the left leg, came out on the side toward Mr. White, and hit the ground half way between him and the animal!

So the poor soldier may be shot in the watch pocket and have the bullet emerge under his left toe.

Roosevelt was the first writer to call attention to the peevish disposition of this bullet. He took to Africa a lot of regular army spitzer bullets and some 220-grain soft point—dum-dum—jacket bullets. In two weeks he abandoned the dum-dum bullets as being much less deadly than the regular spitzers used in the army rifles of the United States. Mr. White shot 185 head of African game on his first trip with the Springfield and a 165-grain spitzer bullet. He bagged 179 of the 185 hit, showing that the bullet wasted very little time in argument. Understand me, these are full-jacket, sharp-point bullets, with the points untouched, and in no way designed to break up or mushroom. They do neither.

Jack London writes about the ripping, tearing wounds found on the Mexicans at Vera Cruz—all done by the little sharp point bullet in its staggering, tumbling, spinning course through the flesh. On the other hand, the old types of bullets, like those used in the Krag, and in the British 0.303 up to recently, long heavy, metal-patched bullets of blunt point, make clean little holes, and give no such slashing effects.

So, knowing that the Germans, and the French, and the British, and the Canadians—and possibly the Belgians to some extent—all use the spitzer bullet, you can see that the Germans, not reading English shooting literature, might suspect from the effects on their men that the foe were shooting little buzz-saws, not bullets.

Europeans have known for some time of the effect of these sharp point bullets; the Germans should, too. Queerly enough, the German spitzer bullet does not seem to give this slashing, ripping effect; the British report the same effects as those from the older type of blunt nose bullet, clean-cut holes.

Years ago the Russian Red Cross Society asked the Russian Minister of War to inquire into the effects of the pointed bullets, then used for the first time by the Germans and Austrians. The Red Cross people alleged that these bullets had been proved to be unstable, to tip on entering the body, and to keyhole—travel sideways. So the evil effect of the spitzer was a matter of public knowledge years ago, and it seems that the German bullet was not immune.

So, except for the looks of the thing, if the British choose to use their old Mark IV, hollow point, Zulu-killing bullet instead of their Mark VII spitzer, they will be doing the foe a kindness—by departing from the rules of the convention.

Shooting for experiment on the tough Catalina wild goat, I have killed, with a companion, five goats with five shots from the army Springfield. Every one died instantly, yet not one was like any other in the effects. One was slashed open alongside as if hit with a giant knife, and his entire internal economy exposed. Another showed no mark either of exit or entrance, another had a slash along the back where the bullet hit, as if he had been struck with a cleaver, but the bullet had not gone in more than enough to break the spine; while still another had a terrific slashing wound of exit in the shoulder.

## The Nutritious Sugar-beet

THE sugar-beet, due to highly efficient breeding, yields under existing farm conditions the largest amount of digestible dry substance per acre of any crop grown. Northern Colorado, during the last decade, has produced an average yearly crop of about 12 tons of sugar beets per acre, containing 22½ per cent digestible dry substance and about 9.6 tons of tops per acre, containing 15 per cent digestible dry substance, or a total of 8,200 pounds of digestible dry substance per acre, if all of it could be utilized as a stock food. The immensity of this figure will be more apparent when it is realized that it would take a crop of 100 bushels of corn and 4½ tons of fodder per acre, or a crop of 8.2 tons of alfalfa per acre, to equal the quantity of digestible food produced by the sugar-beet. Although such crops of corn and alfalfa are possible, they are rarely, if ever, produced, while the sugar-beet crop mentioned has been grown on an average for ten years in the vicinity of Fort Collins, Col. In fact, during these years a large proportion of the growers have exceeded this average, while in favorable crop years the entire average has been considerably higher.

Of course, the cost of growing an acre of sugar beets is considerably higher than the cost of growing a like area of corn or alfalfa; but this is offset by the fact that, by means of the sugar factory, it is possible to extract from the beet a portion of the digestible dry substance in the form of sugar, to the extent of from two to three thousand pounds per acre. The price obtained for the sugar covers the expenses and profits of farm and factory, so that the remaining food properties may be sold at prices below the level of equivalent available foods.

At present all of the available food value of the sugar-beet is not realized. This is due partly to the indifference of the farmer, partly to the fact that feeding on a small scale on the farm is not popular, and partly due to the recent establishment of the industry and the uncertainty that heretofore has discouraged the factories from investing permanently the large sums necessary to obtain all of the food content possible in the most economical form.

## A Substitute for Glass in Automobiles

FOR many years it has been one of the endeavors of automobile body manufacturers, especially of limousine and sedan bodies, to find a substitute for the dangerous glass, used as windows in these motorcars. Several types of "safety glass" have been proposed, but for some reason or other it has been found impossible to eliminate the splintering glass with its danger of cutting the passengers in a collision. In tops for touring cars, on the other hand, celluloid and mica have also been found very unsatisfactory, and their continued use has been continued for the simple reason that nothing better so far has been discovered.

Now, however, a material has been brought out by one of the largest manufacturers of explosives in the world, under the trade-name *Cellon*, which possesses some remarkable qualities. In the first place, it is almost unbreakable by ordinary handling. Sheets of this material can be bent backward and forward many times, without breaking; blocks of this transparent product can be subjected to blows without showing fractures; it can be produced in any desired thickness, up to half an inch, in plates measuring 140 by 60 centimeters. In rods and tubes the material can be had in any desired thickness. Clear and completely transparent, light or dark colored, mottled or even black, it can be used for the manufacture of all objects now made of celluloid.

Its chief advantage over celluloid is its safety against fire. A sheet of cellon may be ignited by an open flame, but the burning portion will melt and a few drops of the material will fall to the ground. It will not continue to burn. Its weight can be calculated for any desired thickness and size from the statement that a plate 60 by 140 centimeters, 1 millimeter thick, will weigh 1 kilogramme. Translated into inches and pounds, the material weighs about 2.6 ounces per hundred square inches of 0.04 inch thickness.

Cellon is fastened by nailing it down, thin sheets by sewing on; it can be glued on by the use of "cellon-lack." It is used for telephones, electric switch boards, toilet articles, windows for automobiles and aeroplanes and dirigibles (see Zeppelin passenger ships), and is a perfect isolating material for all electric apparatus; can be cut and trimmed with an ordinary knife; warmed in hot water and then molded in any desired shape; is impervious to water, gasoline, petroleum, oil, turpentine, and gas.

Cellon-lack, the new varnish made with cellon as a base, promises to become invaluable as a varnish for aeroplane and balloon materials, because of its resistance to the influences of gasoline, oil, and water. Instead of reducing the tensile strength of these materials, cellon-lack is said to increase it.

While at present there seems little chance of this material being introduced in the United States, the end of the present war will undoubtedly see its use in American industries. The process of manufacture is patented by Dr. Eichengruen, in Germany.

## The Work of the "Scotia" in 1913

THE British government has just published in two volumes, one of text and one of diagrams and charts, the detailed scientific results attained in connection with the ice patrol of the "Scotia" in 1913. It will be recalled that after the loss of the "Titanic" in April, 1912, attention was called to the question whether any steps could be taken to render Atlantic steamship routes more safe by establishing an ice patrol to the north of these routes, and in the following spring the "Scotia" was sent out experimentally for this purpose at the joint expense of the British government and the shipowners. The scientific staff included a hydrographer, a meteorologist, and a biologist. The expedition sent daily wireless reports on the state of the ice and the weather to the nearest land station, whence they were ultimately distributed to vessels and to the hydrographic and meteorological offices of the United States, Canada, and Great Britain. The scientific work included a wide range of hydrographic, meteorological, and biological investigations. Fog, which is no less important than ice in the area under investigation, was the subject of numerous observations, in which good use was made of meteorological kites. The whole undertaking was so successful that the International Conference on Safety of Life at Sea, which met in London in November, 1913, established an international ice patrol to continue on a larger scale the work initiated by the "Scotia."

## The Current Supplement

MANY branches of modern science depend for their interpretation and explanation on the "ion," and a thorough understanding of ions and atoms, and their relationship, is indispensable to the modern scientist and necessary for the understanding of scientific literature. Many will find the lectures on this subject by Sir J. J. Thomson, the first of which appears in the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT, No. 2052, for May 1st, 1915, absolutely invaluable. An article on vocational guidance is a particularly timely topic of modern welfare. There is an illustrated description of the operating mechanism of the U. S. collier "Jupiter," telling how warships are coaled at sea. How the rifling of the barrel of a firearm affects the flight of a bullet is explained in a most interesting article, with several diagrams. There is a discussion of the dyestuff situation. Notwithstanding all that has been written about the conduct of the great war few appreciate how widely the automobile truck has been utilized and the great variety of different tasks which it is successfully performing. Something of this is told in the article on The Motor Truck in Modern Military Service. Another matter of interest is the description of the manufacture of gasoline by "cracking" crude oils. Much has been printed about the German "Taube" aeroplanes. An account of the evolution of this type, with a number of diagrams is given. An important subject is the formation of ozone in the upper atmosphere, and the article begun in this issue treats of experiments and observations made for determining this question. There are also articles on gaseous explosions; a steam-electric wrecking crane; the evolution of the elements, and a consideration of the work of Prof. Arthur von Auwers, the astronomer.

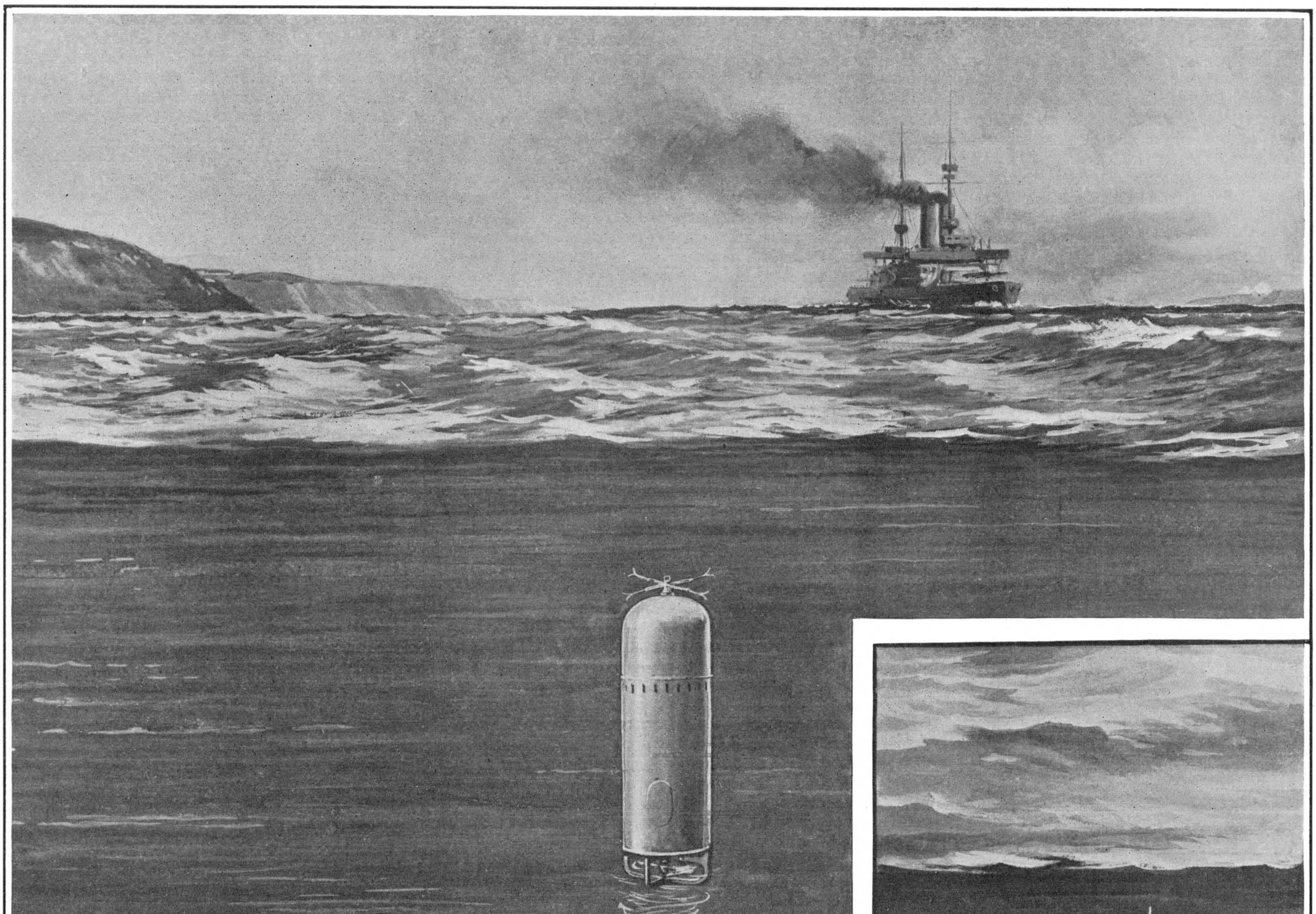
## Hand Firing of Soft Coal

IT is not often that a Government bulletin attracts more attention or promises more real benefit in its sphere than the Bureau of Mines publication on Hand Firing Soft Coal Under Power-Plant Boilers. It chronicles the results of actual tests and seeks to so present the subject as to meet the need of men without technical education. So far as possible it avoids technical language, and it is so worded and illustrated that it will aid the work of practical firemen and should be the handbook of all engineers and firemen capable of following printed instructions.

## To Old Readers of the Scientific American

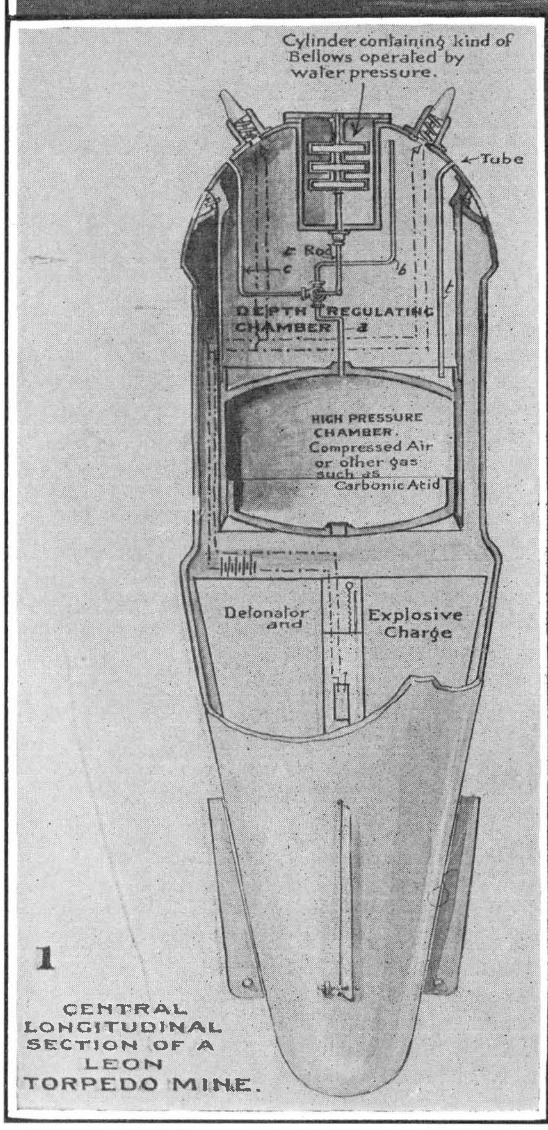
THE June number of the SCIENTIFIC AMERICAN will commemorate the seventieth anniversary of the house of Munn & Co. In that number we wish to give a history of the SCIENTIFIC AMERICAN. Old readers and subscribers who visited the editorial offices in the past are requested to send us their impressions, anecdotes, experiences, and the like. Indeed, any information at all relating to the old offices on Park Row will be gratefully received by the Editors.

# SINKER OF THE "BOUVET," "IRRESISTIBLE," AND "OCEAN"?




By courtesy of *The Illustrated London News*

**Fig. 2.—Showing how it oscillates in the water. The latest type of Leon torpedo mine.**




Drawn by W. B. Robinson

**Fig. 1.—A Leon torpedo mine shown in section. The earlier form.**

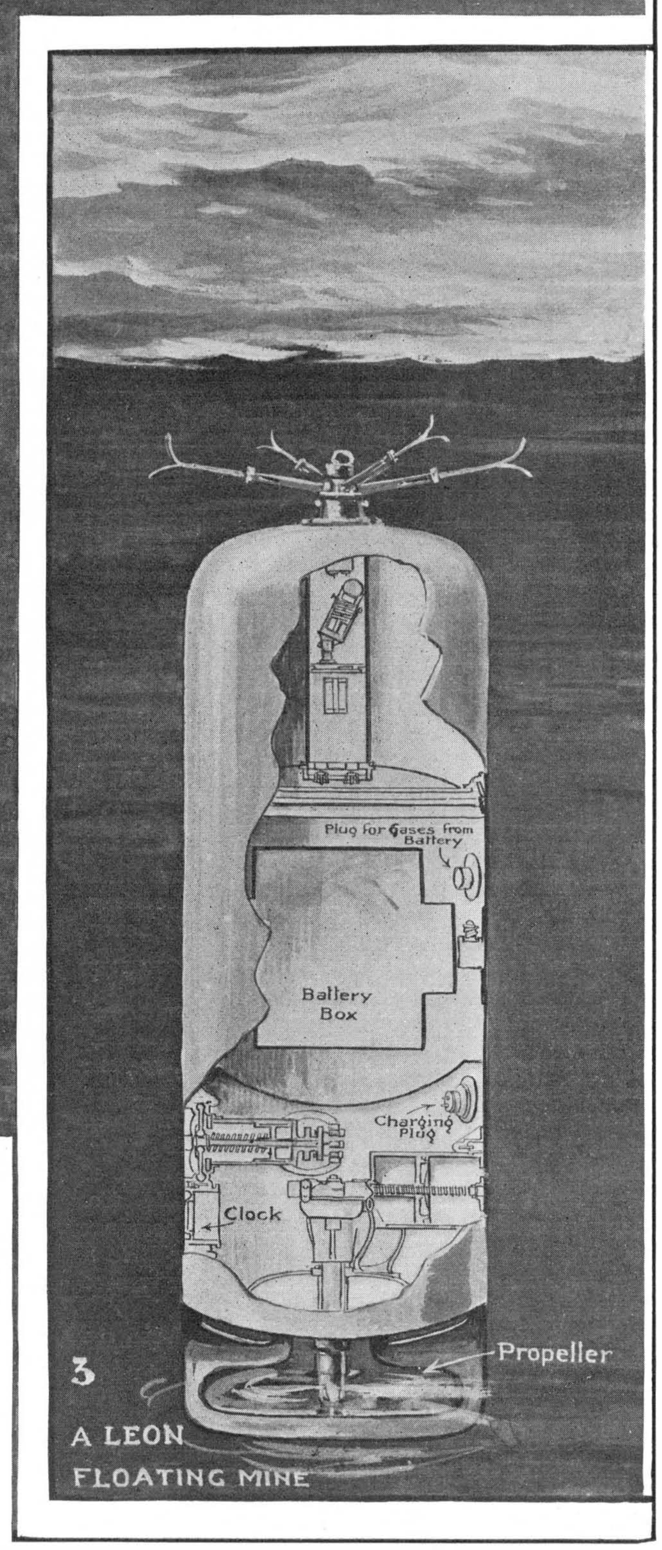



**Fig. 3.—The latest type of Leon torpedo mine. A sectional diagram.**

THE French battleship "Bouvet" was stated by the British Admiralty to have been "blown up by a drifting mine" in the Dardanelles; while H.M.S. "Irresistible," "having probably struck a drifting mine," and H.M.S. "Ocean" "also having struck a mine, both vessels sank in deep water." It has since been reported, unofficially, that the type of drifting mine used by the Turks is believed to have been the Leon torpedo, two forms of which are illustrated on this page. That on the left (Fig. 1) is the earlier of the two, patented in 1907. Fig. 3 represents its latest development, and Fig. 2 shows how it oscillates vertically in the water. This mine was invented by Capt. Karl Oskar Leon of Karlskrona, Sweden. A torpedo mine is so called because it can be ejected from a tube like a torpedo. It does not, however, move horizontally like a torpedo by its own power, but it can be set to oscillate more or less vertically beneath the surface at any desired depth. In the type shown in Fig. 1, the oscillating mechanism is regulated by means of compressed air in a chamber within the mine. The bellows are extended by increase of water pressure and contracted by its decrease. Water is admitted to the depth regulating chamber and expelled from it through the tube *t*, which communicates with the water surrounding the mine. The explosion of the mine is caused by impact with the two spring-pressed horns seen projecting at the top in Fig. 1. The mine shown in Fig. 3 floats almost vertically in the water. It sinks to a certain prearranged depth at which the propeller is automatically actuated to drive it up again. The action of the propeller can be made to begin and cease at any depth desired. The time during which the mine is to float can also be regulated.—[*Drawings Copyrighted in the United States and Canada.*]

# Correspondence

*[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]*

## Military Preparedness

To the Editor of the SCIENTIFIC AMERICAN:

I have been much interested in your articles on our military preparedness. I was a member of the cadet organizations at Pennsylvania State College, where I graduated a few years ago, and where I ranked as captain. I feel that your comments upon our training are true, that the training of such camps (summer training camps for officers) as you describe would be very good. W. J. DUMM.

Newark, N. J.

## Military Drill in Place of Gymnasium

To the Editor of the SCIENTIFIC AMERICAN:

I have read with much interest the articles on "An Undefended Treasure Land" and am heartily in sympathy with them, as I believe are the majority of our people. I have wondered if the idea had ever been suggested, that the various State universities substitute a military drill for the gymnasium, or at least make it optional, and allowing the same credits as for gymnasium work. It seems to me that this would be of great benefit to the student and at the same time give us a large body of well-drilled men.

Boulder, Col. ERNEST GRILL.

## Military Drill in the Public Schools

To the Editor of the SCIENTIFIC AMERICAN:

Now that the "fad" is to talk about "whether our standing army is sufficient or insufficient in case of war," I wish to suggest the following:

Instead of increasing our standing army so that we may have a stronger military protection in case of war, why not have military drill-masters at our public schools and thus have every boy, say from ten years up, trained to military tactics? Not only would it be of benefit to the youths from an athletic standpoint, but it will also create a *drilled reserve* of those who, as a rule, volunteer their services in case of war.

The cost to the Government of keeping drill-masters at the public schools would be comparatively with other means, very small. In order to create enthusiasm and interest among the youngsters, the forming of companies, regiments, etc., and promotion in rank should be given to those who deserve the same. This will keep the young ones interested in their military training as well as the rest of their school studies.

However, this is merely a suggestion, and if you consider it practical and sane, I will appreciate your comment on same. MARTIN I. ZOFNESS.

## A Letter from an Old Reader

To the Editor of the SCIENTIFIC AMERICAN:

It may be of interest to you in connection with your anniversary number, which I notice is soon to appear, to realize how important the SCIENTIFIC AMERICAN was regarded by practical men in its earliest years. Along about 1851 or 1852, when I was an apprentice in the machine business at Baltimore, my preceptor, a man named Shipley, showed me a copy of the SCIENTIFIC AMERICAN and told me that I should subscribe to it, as it would be of assistance to me in my studies relating to the business which I expected was to be my life's work. I followed his advice and subscribed to the SCIENTIFIC AMERICAN and continued to read it for years with great advantage, and I take pleasure at this time of life in writing you to such effect.

Washington. D. C. R. C. GILL.

## The Drug Habit

To the Editor of the SCIENTIFIC AMERICAN:

A recent note credited by you to a publication of the United States Public Health Service, and concerning the use of narcotic drugs, is likely to give a wrong impression regarding the prevalence of this condition, because the publication of the Public Health Service is based on data which have since been greatly extended.

Under the permit system therein alluded to, our data up to March 1st, show about 2,500 addicts of the opiates. We estimate that this is about one half of the number in the State and possibly even a smaller proportion. Since this State has about $2\frac{1}{8}$ per cent of the whole population of the United States, if we assume that Tennessee has only the same proportion of addicts as of population we have about 225,000 addicts in the whole country. But Tennessee being an agricultural State, and, therefore, decidedly more free from such addictions than those States where the pressure of modern life is harder, we should add 10 per cent at least to this number, giving us in round numbers 247,000 addicts of the opiates alone. It is safe to say that there are 250,000 addicts of the opiates in the United States, and that they annually use about $6,500,000 worth of the drugs unnecessarily.

This is very different from the 2,000,000 at which the figures have been set by somewhat sensational writers, but it is bad enough, as the addict of the opiates is ordinarily to be classed as a defective. The Harrison Act restricting traffic in these drugs was not passed a moment too soon, and appears to have accomplished an enormous amount of good, for, under our form of government, only national legislation on this subject will absolutely prevent illicit traffic in these drugs within the States.

The Food and Drugs Department of Tennessee is the enforcing agent of this law and the figures given above are taken directly from our books.

Nashville, Tenn. LUCIUS P. BROWN,
Food and Drugs Commissioner,
State of Tennessee.

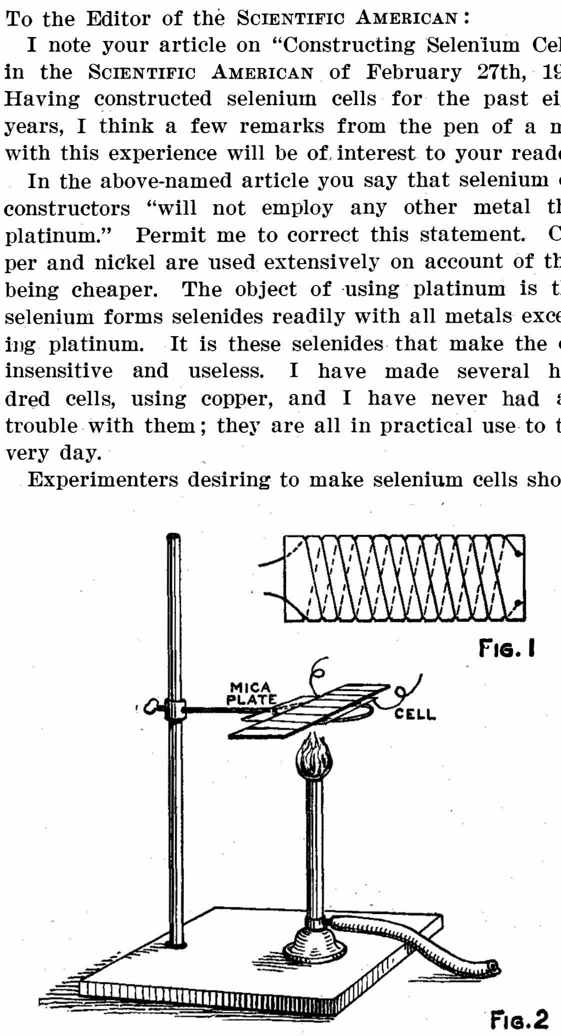
## Construction of Selenium Cells

To the Editor of the SCIENTIFIC AMERICAN:

I note your article on "Constructing Selenium Cells" in the SCIENTIFIC AMERICAN of February 27th, 1915. Having constructed selenium cells for the past eight years, I think a few remarks from the pen of a man with this experience will be of interest to your readers.

In the above-named article you say that selenium cell constructors "will not employ any other metal than platinum." Permit me to correct this statement. Copper and nickel are used extensively on account of their being cheaper. The object of using platinum is that selenium forms selenides readily with all metals excepting platinum. It is these selenides that make the cell insensitive and useless. I have made several hundred cells, using copper, and I have never had any trouble with them; they are all in practical use to this very day.

Experimenters desiring to make selenium cells should not make use of a slate base, as the metallic veins short-circuit the cells. The best material I find for a base is either soapstone, mica, or porcelain.




**Construction of selenium cells.**

As explained by the writer in a recent issue of *Electrical Experimenter*, a selenium cell of the "Bidwell" type can be made by taking a slab of the above-named material, bifilar shape, $2\frac{1}{4}$ inches long and $\frac{3}{4}$ inch broad, and beginning at $\frac{1}{4}$ inch from one end, wind round it in the form of a flat spiral some No. 40 copper or nickel wire. The pitch of each turn of the spiral is $\frac{1}{16}$ inch from its neighbor. Continue winding up to $\frac{1}{4}$ inch from the outer extremity, then fix the two ends of the wire, by passing them through holes drilled in the slab. Now take a second wire and carefully wind this on beside the other, thus forming a second spiral, the turns of which are midway between those of the original one. Fix this as before (Fig. 1). Great care must be exercised that the two wires do not touch each other at any point. It will be well to make sure by testing this with a telephone receiver.

For the succeeding operation a retort stand at least 15 inches high is convenient. Fix the ring 15 inches above the base; on the pedestal place a Bunsen burner. On this ring (Fig. 2) lay a flat sheet of brass $\frac{1}{16}$ inch thick, and on the brass a piece of mica (to save waste selenium). Place the embryo cell on the mica plate, having brought the Bunsen burner close under the brass, melt a few grains of stick selenium in a small spoon and let four or five drops fall upon different parts of the cell. Spread the melted selenium evenly over the surface with a piece of mica, a steel knife or spatula, and at the same time pressing it well between the wires.

During this process the temperature must be carefully regulated by raising or lowering the temperature of the Bunsen burner. If the temperature is not high enough the selenium will begin to crystallize; if too high, the selenium will collect in drops, being apparently repelled from the surface of the cell. The temperature should, in fact, be just above the fusing point of crystalline selenium. When a smooth surface is obtained, quickly remove the cell with pliers and let it cool. Its surface will now be smooth and lustrous.

The cell must next be annealed. The brass plate being cool, lay the cell upon it again, and adjust the burner at its lowest possible point. The selenium will soon begin to crystallize, as evidenced by its surface assuming a dull leaden appearance. (If crystallization has not begun in five minutes, raise the burner an inch or two.) In from five to ten minutes the whole of the selenium should be crystallized. Then gradually raise the burner until signs of fusion just begin to appear. This will probably take place when the flame is within three inches of the brass. Instantly remove the burner, and in about ten seconds re-crystallization will occur. Now fix the burner $\frac{1}{2}$ inch below the point at which it was when fusion commenced, and let it remain for four hours, merely looking at it from time to time to ascertain that, owing to increase of gas pressure or other causes, the heat has not become too great. After four hours, begin cooling by lowering the burner an inch or two, and repeat this operation every ten or fifteen minutes, until the burner is at its lowest point. Then slightly lower the gas flame at short intervals, until it is finally extinguished. When the brass plate is quite cool, the cell may be removed.

A cell made in this manner is found to have a resistance in the dark of from 50,000 to 100,000 ohms.

New York city. SAMUEL WEIN.

## A "West Point" for Non-commissioned Officers

To the Editor of the SCIENTIFIC AMERICAN:

All but a few extreme pacificists will admit that the United States is not properly prepared in a military way for even the smallest war emergency. All but a few extreme militarists will admit that the United States does not need an enormous standing army. Between these two extremes, is not the following plan sensible, logical, and practical?

Should war be declared, the graduates of West Point will provide material for officers of the very highest type and training. The young men of America between 18 and 40 will provide material for the common soldier second to none in the world. The great lack will be in the non-commissioned officer.

I think it will be admitted that an army of recruits can be whipped into form by a West Point officer in a very short space of time when he is properly supported by non-commissioned officers. Upon the supply of non-commissioned officers will therefore depend the quality of the American army and the length of time necessary to form it.

I wish to suggest the organization of a second "West Point" for the training of non-commissioned officers. Men should be admitted to this academy upon the same competitive basis that is required for admission to West Point. They should be trained to become properly complementary to the regular commissioned officers. They should be educated to take charge of the humbler tasks of war—the digging of trenches, the throwing-up of fortifications, bridging rivers, etc. They should be trained to drive engines and automobiles, to guide aeroplanes, to erect wireless stations. They should be made adept, as a matter of course, in military drill. In short, they should be educated scientifically to fill that humble but vastly important place in army management which heretofore we have left to chance and costly experience.

But—and here is the real merit of the proposed plan—they should be so educated that the knowledge they acquire in the arts of war may be equally valuable to them in the arts of peace. Instead of training them solely for a war that may not come in their generation, their training should be such that they will leave the institution equipped to take a skilled man's part in the industries of the country.

In payment for this education, they are to be subject to the call of their Government. They might even be required to spend a short term of years in the regular army. But, depend upon it, if our Government will equip men with such a training no reasonable requirements of service will prevent thousands of young men from competing for the opportunity to enter such a school.

With trained and experienced officers and non-commissioned subordinates, an American army could be mobilized and trained in an incredibly short space of time. Then let the Government work more closely with our national guard, compensating the young men who are giving their time and energy to this thankless work. Let a system of medals be provided for excellence in sharpshooting by civilians and for military drills by citizen-bodies.

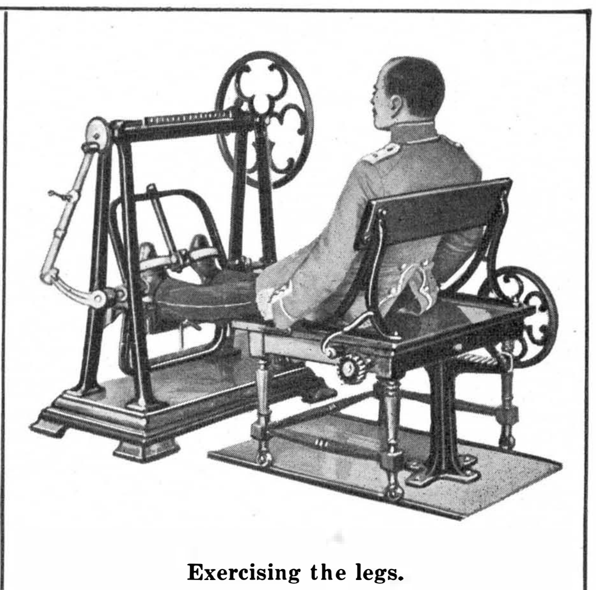
The result of this would surely be the creation of a great army of peace which could at short notice be transformed into a vast army of war that would creditably represent and defend the peace and dignity of the United States. F. C. BUTLER,
Secretary, Chamber of Commerce of Kalamazoo.
Kalamazoo, Mich.

Pedal which bends and stretches the foot.

# The Mechanics of Convalescence

## Methods of Hastening the Cure of German Wounded Soldiers

By Walter Bannard



Exercising the legs.

MEDICINE and surgery have had a very serious task set before them in the handling of the vast hosts of wounded men in all the belligerent armies. It is to the credit of the members of the healing profession that, both as individuals and organized bodies they are coping courageously and wisely with the great undertaking so suddenly thrust upon them. So far as known, they have never failed to give their Samaritan care impartially to friend and foe. Someone has said that the curative art is the only present-day branch of science which is benign to all men alike. There is sore need of some benign influence in the terrible struggle, for the injured men already under care may be far exceeded in numbers by those wounded in the coming days of the war.

Outside of inoculation for tetanus it is stated that no strikingly new treatment has so far appeared in the care of wounds and disease, unless the vaccine for typhus just announced should prove its utility. The work done has been largely the application of the advances of medical and surgical science in the cure of the ordinary ailments and accidents to which mankind is liable. These advances, though, have of late years been very great. There is above all the advance, most important in surgery, in the prevention of blood poisoning, there are the increased knowledge of sanitation, the use of the Röntgen rays, and the benefits arising from other recent discoveries in the art of healing. Owing to all these improvements, we are told, large numbers of the wounded are rapidly cured and returned to the front.

It is not at all strange that the medical and surgical skill of times of peace should be so successful in the era of war. Rheumatism, pneumonia, and typhus are much dreaded diseases of camp and trench life, and the treatment of fractured bones or other bone injuries by shot resembles that of accidents to the bones in ordinary life. The main object in the surgery both of war and peace is to restore as completely as possible the natural functions of the injured parts, so that the improvements in the treatment of accidents made of late years can now be happily used to shorten the soldier's convalescence. Heat, light, and electricity, which have all their successful applications in medical and surgical science, have been turned to good account, and mechanico-therapy has proved of much value, especially in the after-treatment of injuries which leave stiffened joints.

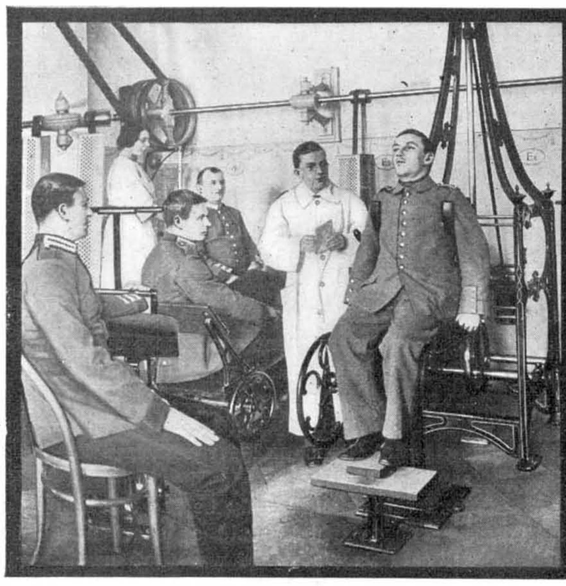
The methods of mechanico-therapy are not largely used in the United States. This system of treatment had its origin in Sweden and its theories have been largely developed in that country and also in Germany, where the use of machinery in the cure of injuries to the bones, nerves, and muscles is widely extended both in hospital and private practice. Dr. Charles H. Jaeger, the well-known authority on mechanico-therapy, states that, in reply to his inquiry, some six hundred institutions and physicians in Germany said they used medico-gymnastics to hasten convalescence not only in affections of the joints, but also, in many instances, in diseases, as pneumonia and pleurisy, and after operations not referring particularly to joints. Most of them had been using this treatment for a considerable period of years, and convalescence, in the general opinion, was decidedly shortened thereby. One reason for the large use of mechanical methods in the treatment of injuries in Germany is the compulsory state insurance of workmen, which obliges the employer to bear the greater part of the expense of illness from accidents. This naturally leads the master to seek after methods for shortening the duration of the workman's inaction, and Germans declare that mechanico-therapy has proved a good way of detecting the lazy worker who wants to live off the insurance fund. This form of treatment being of such general use in Germany, it is not surprising that the military hospitals there are largely equipped for it, as the illustrations show, a provision which now stands them in good stead.

The mechanical treatment is generally an after-treatment, although it may begin before the injured bone or joint is entirely healed. It is based on the idea that lack of use leads to lack of nutrition and atrophy of the part, and its aims are the improvement of nutrition and the maintenance of functions. It seeks to attain these ends by massage and gymnastics. Various kinds of machinery are used which have different methods of maintaining movement, but the force of all is adjustable and the movement is defined. The movements are active, the patient taking part, passive, in which the patient is acted upon without his own exertion and resistant, in which the machine exerts a regulated resistance to the action of the patient. In these exercises the patient stands, sits, or lies, according to the treatment required, as may be seen from the illustrations. Among the apparatus used is machinery for bending, stretching, or rotating various joints which may be stiffened from trench-rheumatism or from a wound; machinery for expansion of the lungs, thus permitting better oxidation of the blood after a shot in the breast; machinery for producing mechanically such operations as percussion, friction, kneading, or vibration. These last operations are also performed by hand massage. Hand massage is one of the cures of antiquity revived and scientifically developed in the latter part of the last century. The soldier of to-day has the benefit from it once enjoyed by the Roman legionary.

Other aids employed to hasten the cure of soldiers eager to be back at the front are electric light baths, currents of hot air heated and kept in motion by electricity, and electricity in various other forms, as direct and low-frequency currents, which aid in overcoming the paralysis of muscles or nerves caused by a wound. All men who are hurt in a war are not necessarily wounded. In a strenuous life calling for violent exertion many ordinary accidents may befall them, or they may be stunned or otherwise injured by the wind-concussion of the huge shells.

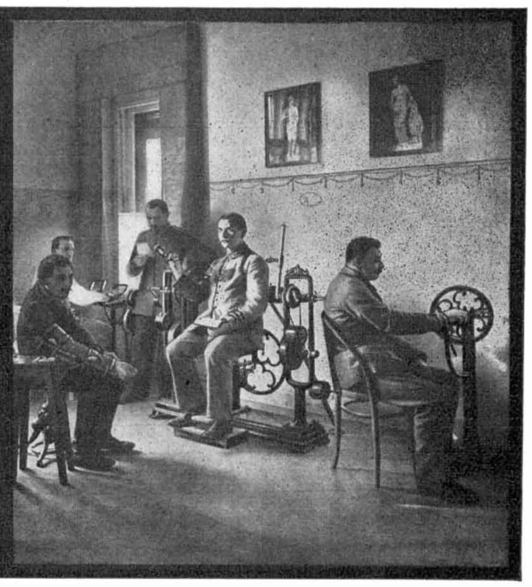
To-day plastic surgery allows the preparation of stumps which can support artificial additions much better than was formerly the case. Maimed soldiers, the melancholy aftermath of war, are not now condemned in as great measure as in past times to inaction and methods of earning a living that are only modified forms of beggary. The belligerent countries are already trying in various ways to meet the problem of equipping the cripples of war for their new conditions of life. In England convalescent crippled soldiers are being placed in homes for crippled children, where they can learn suitable ways of earning a living. The care of maimed soldiers in Germany was assigned last August, only a few days after hostilities were declared, to the German Society for the Care of Cripples, which immediately began to make plans for work on a large scale in connection with the authorities and private benevolent organizations. This journal gave some account not long ago of a book written by a one-armed German, who wished to show German soldiers similarly maimed how to wait on themselves. The same desire to help those of like affliction has led an English officer, blinded in the Boer war, to undertake the teaching of the independence he has gained to men who have lost their sight in the present struggle.

Although science and devotion to the task have wrought so many successful cures in this war, there are injuries which still baffle them. A doctor in an American hospital for the wounded is reported to have



Apparatus for breathing gymnastics and passive expansion of the chest.

A number of electric hot-air apparatus employed for treating stiff joints.



Apparatus for use in limbering up arms and fingers.

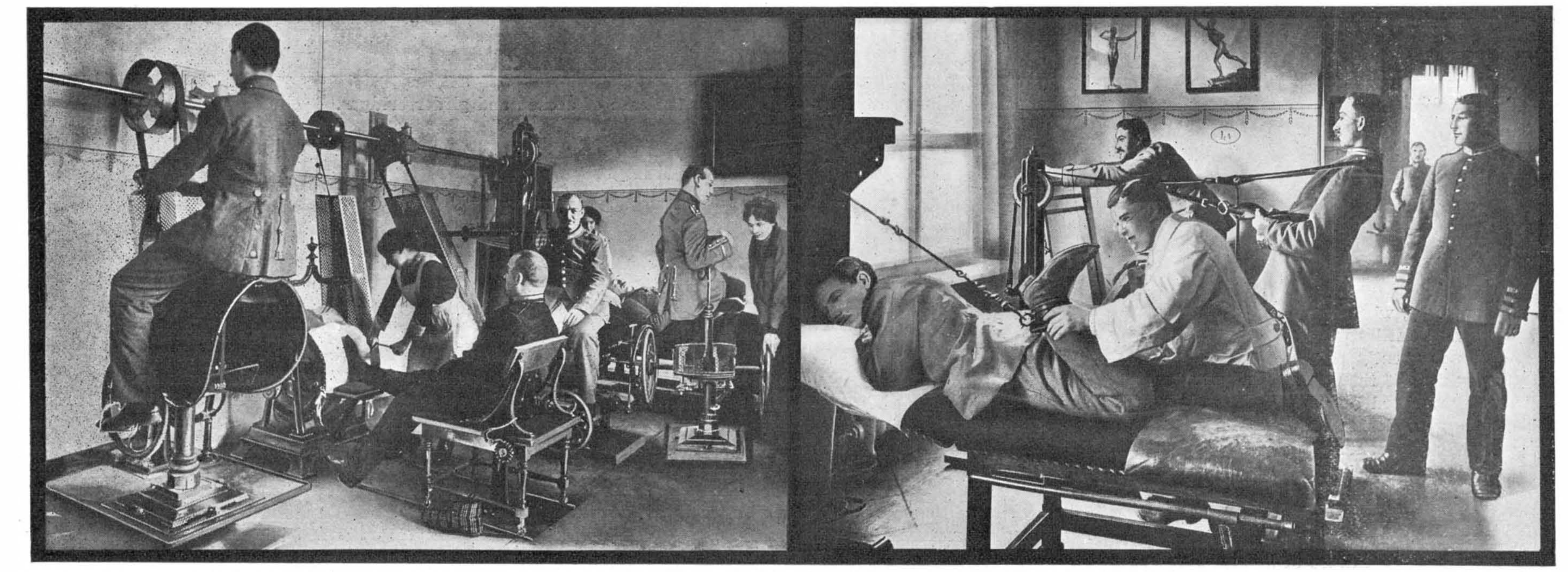
said that the staff had had next to no abdominal cases. This would indicate that such patients are apt to die before reaching the base hospital.

### The Government's Competition for a Naval Dirigible

By C. Dienstbach

THE British War Office transferred, some time ago, all its army dirigibles to the navy. In soliciting bids for naval dirigibles the American Government seems to have been guided in its policy toward the long neglected lighter-than-air machine by the identical considerations which influence the British—that only dirigibles may be depended upon for long-range oversea work. This theory is brilliantly vindicated by the German naval Zeppelins. According to a recent authentic statement, they cruise about over the North Sea as if it were a mill pond and simply shoot down interfering hostile seaplanes. This must be borne in mind to appreciate the published conditions of the American dirigible contest.

Appropriations by Congress are scanty, even for inexpensive aeroplanes, of undoubted utility, and with the memory of the sensational failure of the large British naval airship "Mayfly" still sufficiently fresh, it is not surprising that these conditions ask for a "sample" airship of pigmy dimensions, as dirigibles go. But it is rather misleading, when the Government calls this a Vedette type. This French term means essentially a small army dirigible, a "disguised aeroplane" of short range, almost as easy to provision, transport, store, and operate, but also of marked simplicity. Any reduction of the "aerial dreadnought's" resourcefulness finds there no more room than in the average aeroplane. realize on a similar displacement. But in this way the first American naval dirigible, except that it will furnish a test of technical skill, materials and workmanship available in the United States (the clause stipulating continuous Government inspection of the materials and the building process seems very wise) will be useful only as a training ship. (The stipulation for a numerous crew seems moreover to make this special purpose clear.) But the conditions will not in themselves guarantee that the winning design may also be a proper stepping stone and model for larger units. They rather seem to invite the reverse. Obviously, for instance, the lightest aeroplane engines will be equal to a run of only two hours, and the temptation is great to dodge in this way—decidedly poor dirigible practice —other difficulties of getting the most out of the allotted weight. It would be a very complicated undertaking to ponder all the advantages and disadvantages of a hundred different compromises to comply with the exacting conditions, but it may be safely stated that they generally tend toward the small, sturdy British "Greek Letter Type," with much lift for its dimensions, and permitting of a good deal of useful equipment, such as, for instance, the swiveling propeller specially demanded in the American competition, but slow and decidedly no model for enlarged units. Speed is the prime requisite in a dirigible, because head resistance increased with the source of the velocity and a true Astra-Torres Vedette of forty miles an hour on 156 by 27 feet has actually proved the best model for enlargements. It is easy to make use of the extra lift gained by increasing the size for supplying any amount of equipment, but to improve inherently slow speed by mere enlargement is a much less efficient proceeding, in any competition. The system which favors



Motor-driven apparatus for massage of foot and back and percussion of arm; to left, convalescent on riding apparatus.

Medico-mechanical treatment of members stiffened by wounds; passive extension of knee and trunk.

Renard, the ingenious designer of the first true dirigible, "La France" of 1884, excused his failure to follow up his success with these words: "What are two hours! A dirigible which cannot plough through the air for twenty hours is useless." Renard's opinion is revived in reading conditions which ask for only two hours' running at full speed.

In the true Vedette type every other advantage is, for good reasons, sacrificed to vital radius of action and speed, both so difficult to attain with a small dirigible.

Far from being a Vedette, the airship aimed at by the Government's conditions tends to become a "miniature Zeppelin," not the least by religiously obeying the much-debated "full crew law." From the four-men crew of a Parseval Vedette of 128 feet length, 25 feet beam; a Zodiac Vedette of 134 feet length, 28 feet beam; an Astra-Torres Vedette of 156 feet length, 27 feet beam, with displacements ranging from 42,384 to 54,746 cubic feet, to the eight men crew demanded for the first United States naval dirigible of 175 feet length, 35 feet beam (and corresponding displacement with a Parseval hull of 81,155 cubic feet, with a Zodiac hull of 80,727.50 cubic feet, and an Astra-Torres hull of 79,625 cubic feet) is not a short step. But the conditions also call for an inclosed car to serve as a boat. What that imposes the designers of Brucker's transatlantic airship have found out. There must also be swiveling twin propellers, double ballonet control, combined with horizontal rudders, two motors, mooring arrangements, and possibly wireless and lighting equipment, and stabilizers.

Evidently the first United States naval dirigible is to be as complete as a modern automobile. To offset these exacting demands the speed has been reduced to less than four fifths and the radius of action to less than one third of what a true Vedette could speed (and incidentally a wide radius of action) most for any given size should be put at the highest premium. While there seems little doubt that the submitted designs will not be judged merely by their close conformation to the conditions, but by their general excellence, there is less assurance of competitors not being guided too much by the mere conditions. They would be justified if the competition were only for the best training ship. In a training ship the principal merit does consist of providing on a small displacement the accommodations and the equipment of a large craft. But in this way it becomes inherently a poor model to enlarge. In the details of the conditions due consideration has been given to modern experiences. The importance attached to mooring the ship to a mast in a fifteen mile wind, and to its ability to weather a forty-mile gale while thus anchored deserves special credit.

Perfecting accessories furnishes likewise a stepping stone to enlarged units where they are indispensable, only of less importance than insuring speed. Complications are even easier on a small scale owing to the relative strength of materials inversely increasing with size.

### So-called Humane Bullets

WE are told in the current newspapers that Alexander Foster Humphrey of Pittsburgh has invented a bullet supplied with narcotics and antiseptics, the former to relieve the pain of a wound and the latter to aid the healing operations. At least two patents have issued for narcotizing bullets, both especially designed for use in capturing the lower animals. One patent issued in 1910 to James Francis O'Byrne and Thomas A. Flood of Salt Lake City for a bullet carrying a narcotic whose anaesthetic effect when shot into a fleshy portion of an animal would so affect it as to render its capture and control comparatively easy. The other patent was issued in 1911 to K. Burgsmüller of Kreiensen, Germany, for a cartridge filled with a mixture of capsicine in an immediately gasifiable form for narcotizing animals.

### A Welcome New Scientific Journal

IT is a well-recognized fact that the progress of science is seriously impeded by an overabundance of scientific journals. Almost every scientific man finds that a deplorable amount of his time is given to the task of gathering together from scores of periodicals the *disjecta membra* of the literature in which he is especially interested, and, to make matters worse, there is always a certain residuum of such literature that escapes his vigilance on account of its out-of-the-way place of publication.

Hence, the advent of a new scientific periodical is not hailed with general satisfaction unless there are very special reasons to justify its existence. Such reasons undoubtedly authorize the appearance of the monthly *Proceedings* of the National Academy of Sciences, which began publication last January. In fact, the *Proceedings* at once takes rank among the few journals that are indispensable.

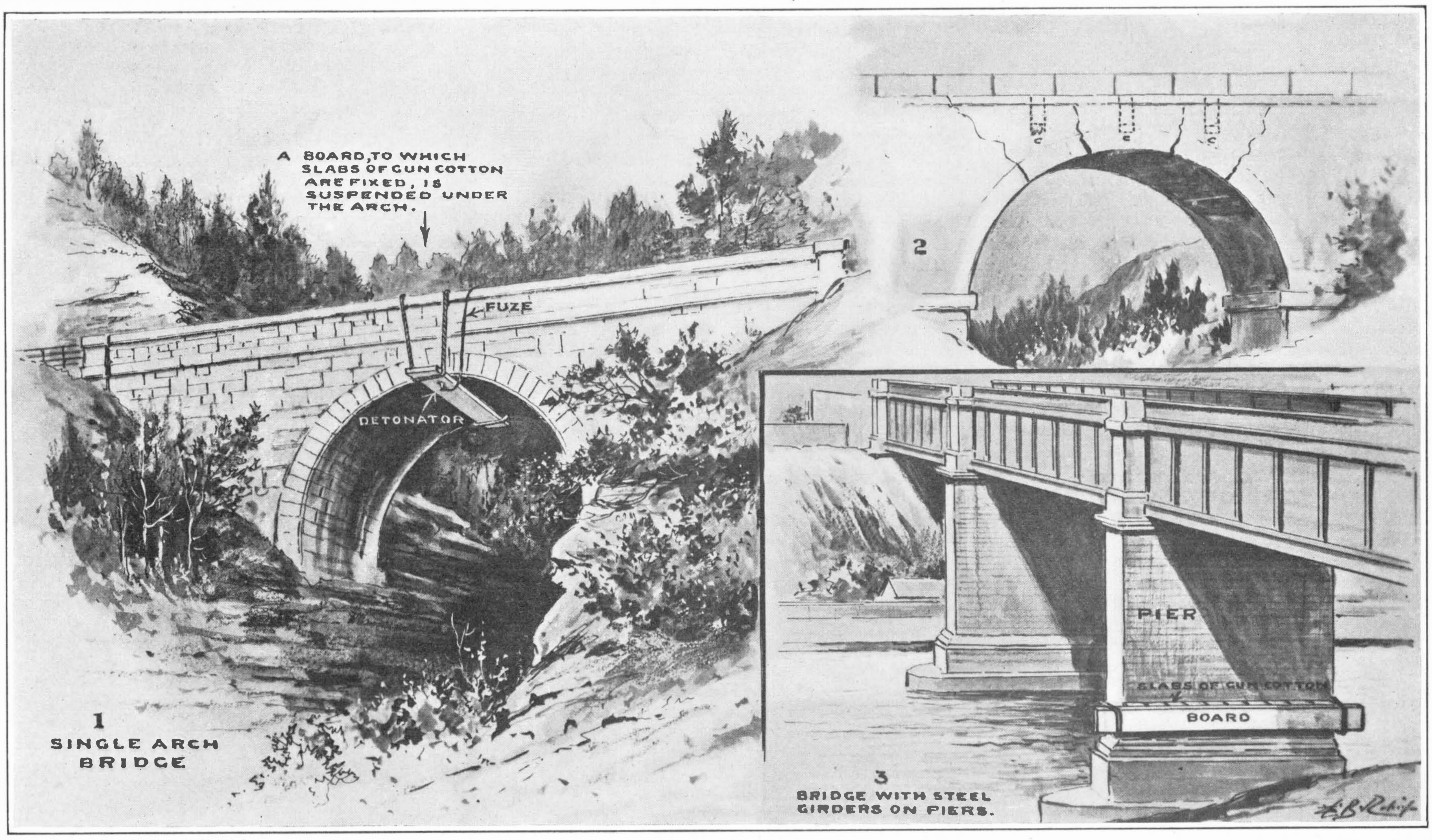
Not long ago we greeted the new *Journal* of the Washington Academy of Sciences, which so admirably epitomizes the progress of science at the capital, as the nearest approach yet realized in America to an analogue of the Paris *Comptes rendus*. This characterization may be even more aptly applied to the new organ of the National Academy. Its aim, as announced, "will be to furnish a comprehensive survey of the more important results of the scientific research of this country." It is not designed to replace or displace any previously existing journal, since its contents will be limited to brief advance notices of important scientific achievements, the more detailed reports of which will appear elsewhere. The maximum length of contributions is fixed at 2,500 words. Authors are, however, cautioned to be precise in making clear the new results and to give some record of the methods and data on which they are based, as well as of the relation which the paper bears to previous publications on the same subject.

The managing editor is Prof. E. B. Wilson of the Massachusetts Institute of Technology.

### The American Hog in New Pastures

IT has remained for American brains and American capital to put to practical and profitable use that greatest of all problems of the hot, low countries of Central and South America—the worn-out banana land. Experiments conducted by American planters have shown that hogs pastured on grass and fattened on bananas produce a superior, almost odorless lard and finely flavored meat. Hogs, it has been found, can be raised on the worn-out banana lands and fattened on the small, unmarketable bunches of fruit borne on these areas. So much for the banana land in the course of its deterioration!

When bananas may no longer be grown, the land will produce bountiful crops of sugar. Two thousand acres, near Ceiba, Honduras, the banana yield of which was long ago exhausted, has so responded to sugar cultivation that a sugar mill has been erected on the premises by the Honduras Sugar and Distilling Company, at a cost of half a million dollars, to take care of the resulting cane crop.




*The Illustrated War News.*

**Bridge destruction methods used by military engineers in the case of arched and girder bridges.**

# Protecting a Retreating Army

## Effective Methods of Destroying Its Lines of Communications

IN times gone by, when armies were of comparatively small size, and battles were largely hand to hand contests, it was frequently possible to subsist the troops upon the supplies of the surrounding country; and as the weapons consisted of single-shot muskets or rifles and cannon of small size, it was not difficult to carry along a supply of ammunition sufficient for a considerable time. Now this is all changed, and continuous and rapid communication must be at all times maintained between the troops and bases of supplies of all kinds, for upon its supplies depends the effective power of an army; indeed a failure of ammunition in a modern war, even for a few hours, often means the defeat and possible surrender, of a numerous army unless it can retire rapidly.

Under these modern conditions, when a retreat is necessary, one of the most effective methods for protecting the retiring army is to destroy the communications behind it; and the most common means of doing this is to destroy the bridges as they are passed, as this effectively cuts off the supplies of the following army, which must wait until these bridges have been repaired or replaced, a work that often requires considerable time. The methods employed in destroying bridges in war time are described as follows in *The Illustrated War News*, published by the *Illustrated London News:*

Bridges may be roughly divided into three classes—namely, arched, girder, and suspension. In order to demolish rapidly an arched bridge having a single span of masonry, it is usual to fracture the crown of the arch, after which the whole thing collapses. To effect this with the least possible delay a board to which slabs of gun-cotton are fixed is suspended under the arch, in contact with the stone-work, the slabs of explosive being fired simultaneously either by a time-fuse or electricity (see No. 1 top of this page). If more time is available for preparation, a hole excavated from the roadway down to the crown of the arch is charged with gun-cotton or dynamite, a time-fuse or electric firing-cable being connected, brought to the surface, and carried to the side of the road in a suitable channel. The whole excavation is then filled in, and the road can be used as long as necessary, but the charge can be fired and the bridge destroyed at any moment. The structure in this case has nothing to show that it is mined, and may therefore be blown up if desired while the enemy is actually crossing it. If sufficient time can be given to the work, a very complete demolition of an arch may be effected (see No. 2) by simultaneously exploding three charges (*c c c*) of dynamite placed in parallel trenches cut across the bridge from the roadway down to the crown. In dealing with bridges constructed with steel girders carried on brick or stone piers, it is usual to destroy the piers by means of mines at the base (see No. 3), and to trust to the consequent fall of the girders so to damage them as to render them useless. When, however, it is thought desirable to fracture the girder itself, a charge of gun-cotton is placed below the top flange on one side, and another above the bottom flange on the other side of the center web, on a bed of clay in each case, the whole contrivance being kept in position by wooden struts. When the two charges are simultaneously exploded the girder is cut through.

To destroy a suspension bridge, it is usual to cut the cables in three places. This is done in each case by exploding two slabs of gun-cotton fixed at right angles to each other, the cable lying in the angle.

The interruption of railway traffic is a comparatively simple matter, a slab of dynamite exploded in close contact with a rail, or when fired between switch or cross-over points, causing such distortion and dislocation of the metals as to stop the passage of trains.

### What "Capturing" German Trade Means

IT is an easy enough matter to speak glibly about capturing German "diverted" trade, but an exhibition which has been open at the Cutlers' Hall in Sheffield recently deeply impresses one with what it really means. The *Engineer* of London points out very aptly that one of the outstanding features of this diverted trade is the making of steel castings for shipbuilders, but that manufacturers are faced with the fact that Germany has been supplying these things to some British yards at fully 50 per cent less than the figure at which they could be made in England. "We cannot say what such castings are costing at the present moment," says our contemporary, "but it is certain that steel prices generally have considerably advanced since the close of 1914, though if the trade is to be retained after the war British manufacturers will be bound to bring their prices nearer to the German idea than perhaps they care to contemplate just now. But the exhibition at the Cutlers' Hall is an absolute revelation in the way of values. A very comprehensive collection of German cutlery has been got together by Mr. Walter Tyzack, under the auspices of the Cutlers' Company, and every article has been ticketed with the exact German selling price delivered in London, so that manufacturers who have essayed to invade German markets may see exactly what they have to fight against. The exhibition concerned the whole of the industry, as, of course, Sheffield cutlery is made from Sheffield steel. Along with razors, scissors, and knives of the highest quality, there were pocket knives at 15 cents per dozen, two-bladed penknives at 6 cents and 8 cents each, Kaffir knives from 15 cents to 32 cents per dozen, champagne knives with two blades, corkscrew and cigar-cutter, at from 60 cents to 84 cents per dozen, cast scissors at 24 cents per dozen, folding scissors from 31 cents per dozen, large cutting-out and shear scissors from 12 cents to 24 cents each, fine hollow-ground razors from $1.70 to $6.32 per dozen, and safety razors in case with an extra blade at from 6 cents each upward. Some of these prices are actually less than the cost of grinding in Sheffield, and the whole display presents a problem to the cutlery industry as to how it can so shape its future methods that the splendid opportunity now offered for capturing new markets may be taken full advantage of. Some of the lines are not worth Sheffield manufacturers' consideration, but many others are, and if it means a thorough reorganization of labor conditions, bringing them more into line with those prevailing, say, at Solingen—the Sheffield of Germany—and the introduction of the most modern machinery, even at the expense of the old handicraft idea, then it looks as if the old order must change, giving place to the new."

### War and the Weather

THAT the weather is a most important factor to be considered by those responsible for the planning of a campaign has become very apparent during the last few months, for of late much has been heard of the difficulties that have resulted from heavy rains in France and the snows of the Carpathians, both of which have seriously hampered the operations on both sides. Winter conditions make the transportation of supplies and the moving of heavy guns matters of extreme difficulty that must be the subject of grave concern for the leaders, and undoubtedly every possible advantage has been taken of such advance information in regard to the weather as has been obtainable. These questions have been the most serious, although the difficulties of moving men, and their comfort in camps and trenches, have also depended greatly upon the weather. Whether Germany took into consideration the weather probabilities for the districts included in the western war zone when declaring war is not known, but this is very possible, as it is generally understood that she did not expect the war to last over two months, and the reports of bad weather in that district did not figure prominently in the news until late in September.

# The Heavens in May

## Determining the Difference in Longitude Between Washington and Paris

By Henry Norris Russell, Ph.D.

THE piece of astronomical work on which it seems of greatest interest to report this month is of quite a different nature from those which have engaged our attention recently, being a fine example of the use of modern methods and apparatus to obtain increased precision in the measurement of a quantity of fundamental importance. This is the difference in longitude between the Old World and the New—to be precise, that between Paris and Washington—which was re-determined by the use of wireless signals in the winter of 1913-14. French and American astronomers co-operated in the work, their observations being made in such a way that the difference of longitude could be found independently from the observations of either nationality. The results of the American parties, which alone have so far been completed for publication, are the object of our present interest.

Ever since the invention of the telegraph it has been a very simple matter, theoretically, to find the difference in longitude between any two places, however remote, which are in electrical communication with one another. It is only necessary to have standard clocks at the two stations to determine by observing the stars the errors (fast or slow) of these clocks at a given time, and then, by sending a telegraphed signal the instant of whose transmission is recorded by one clock, and of its reception by the other, to find by how many hours, minutes and seconds the clock at the eastern station (which, of course, is supposed to keep the *local* time at that point) is fast of the similar clock at the western station.

As every schoolboy knows, this difference of time can be converted into the difference of the longitudes, such as are recorded on our maps, by simply taking 15 degrees for every hour, 15 minutes of arc for each minute of time, and so on.

Theoretically, therefore, this is one of the simplest problems imaginable; practically, it is one of the most complicated and difficult to solve with high accuracy. Some features of it, indeed, may now be said to be in a satisfactory state. Present day astronomical clocks, built with every possible regard for exactness, mounted in underground vaults where the temperature is kept constant from year's end to year's end, and inclosed in air-tight cases from which much of the air has been pumped out, perform so admirably that they can be trusted to carry along the time from one night's observations to another quite as accurately as it can be found on either night by observation, though over longer intervals of weeks or months it is necessary to keep track of the clock's behavior by observations on every clear night. The transit instruments with which are made the observations of the times of passage of stars over the meridian, are also capable of very accurate construction. By a suitable plan of observation, and by continual testing of the nature and amount of their small outstanding errors of adjustment, these can be almost entirely prevented from exercising any detrimental influence. But to eliminate the human factor—the personal peculiarities of the observer behind the eye-piece—is a harder task.

It is an old story that when the observer has to watch the transit of the star over the spider-lines in his field of view, and as it crosses each one, press the key which records electrically the exact moment, the differences of "personal equation" between one man and another may be very considerable. If he waits to see the star on the thread before making the act of will which causes his hand to press the key his signal will obviously be late, and by an amount which will depend on his temperament and mental quickness. Or, realizing this, he may form the habit of pressing the key just before the star gets to the thread, and may over-correct the error and observe early. Worse than these mere "constant errors" is the probability—indeed, the practical certainty—that this error will vary with such things as the brightness of the star and the state of fatigue of the observer.

An ingenious mechanical device, the "transit micrometer," has greatly diminished these errors. It consists of an apparatus which carries a single movable thread across the field of view, and automatically signals the instant when it reaches certain fixed points in this field. The rate of its motion is controlled by the observer, who devotes his whole attention to keeping it upon the moving image of the star, leaving to the automatic part of the device the responsibility of signaling when the star and the wire moving with it reach the standard positions.

With this instrument, the personal equations of the observers are greatly reduced, though not quite abolished. Their remaining influence can be got rid of by having the observers at the two stations exchange places when half of the observations are completed. If before the exchange the combined effect of these personal errors of the observers tends to make the difference of longitude come out too great, after the exchange it will make it come out too small, and the average of the two determinations will be correct (unless, indeed, the personal equations of the observers change during the time covered by the observations, which, for experienced observers, is unlikely).

Finally, after all these difficulties have been surmounted, and the errors of the clocks at the two stations accurately determined, it is necessary to take into account the time which the telegraphic signals take in passing from one observatory to the other. On a direct overland line of reasonable length this is but a very short fraction of a second, but on long submarine cables it may be a very considerable fraction of a second before the electric current, introduced at one end, fills up—so to speak—the large electric capacity of the cable, and becomes strong enough to give a perceptible signal at the far end.

By sending signals through the line first from one end and then from the other this "transmission time" may be cleared out by taking the average, but the slightest difference in the electrical conditions in the two cases will impair the precision of the result.

Wireless transmission of the time signals possesses certain obvious advantages. The speed of transmission is that of light, and, under favorable conditions, the signals sent out from a station close to one of the co-operating observatories can be received both there and at the transatlantic station, simultaneously, and without any intervening repeating apparatus.

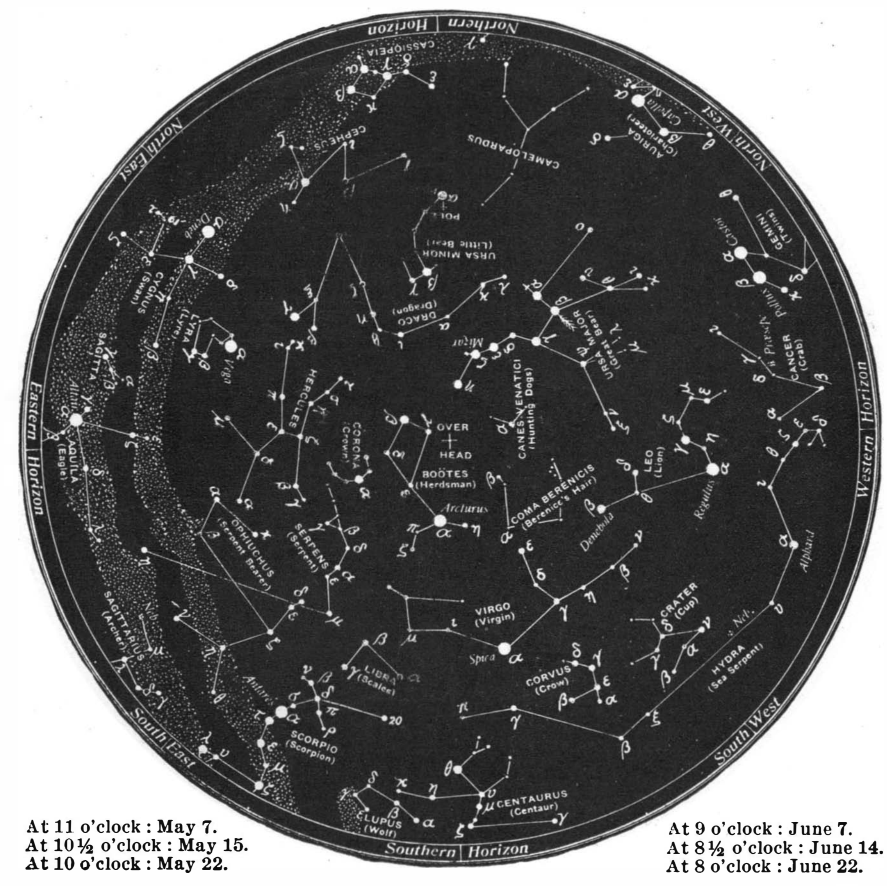
This method, in addition to all the refinements of observation previously described, and many others relating to technical, but vitally important details, has been at the basis of the recent longitude work.

The powerful radio stations at the Eiffel Tower and at Radio, Virginia, across the Potomac from Washington, were put into service and signals sent in both directions after the observers at Paris had completed their observations of the stars, and before those at Washington began theirs. Each set of signals consisted of a long series of half second "buzzes," at intervals not of exactly one second, but of 99/100 of a second so that they gradually drew ahead of the ticks of the clock used for comparison (which were made audible in the observer's telephone). The times of exact coincidence of the clock beats with the beginning of the radio signals could be easily estimated and gave the means of making a very precise comparison between the clocks at the two stations. The over-sea signals were usually very faint and difficult to hear, but satisfactory transmission of signals in both directions was secured on thirty-eight different nights between November, 1913, and February, 1914, and transmission in one direction only on fourteen more nights. The final result of all the observations makes the difference between Paris time and Washington time 5 hours 17 minutes 36.658 seconds, with a probable error of only one three hundredth of a second.

As English and French astronomers have found that Paris is 9 minutes 20.932 seconds east of Greenwich, it follows that the difference of longitude between Greenwich and Washington is 5 hours 8 minutes 15.726 seconds, with a probable error of about one sixtieth of a second. This corresponds to 77 degrees 3 minutes 55.9 seconds.

This is 0.8 second less than the value given in the American Ephemeris for 1915 and previous years. The correction corresponds to a distance of 63 feet on the Earth's surface. The probable error assigned to the new result when reduced to the same measure, corresponds to but *three and one half feet* in the whole distance between Washington and Paris.

Another evidence of the amazing accuracy of this work is that it has been possible to measure the velocity with which the wireless signals fly through the ether. From the results of the thirty-eight nights on which signals were sent in both directions the combined transmission time in both directions across the Atlantic (3,830 statute miles) was found to be 0.0437 second—almost exactly 1/23 of a second, from which it appears that the velocity of the signals was 175,000 miles per second. The probable error of this result is 16,000 miles, or about 9 per cent of the whole. The velocity of light (with which theoretically that of the wireless signals ought to agree) is 186,300 miles per second, and the observed velocity of the wireless signals agrees with this within the error of its determination.




At 11 o'clock: May 7.
At 10½ o'clock: May 15.
At 10 o'clock: May 22.
At 9½ o'clock: May 30.
At 9 o'clock: June 7.
At 8½ o'clock: June 14.
At 8 o'clock: June 22.

NIGHT SKY: MAY AND JUNE

### The Heavens.

The finest region of the evening sky is now to the eastward, where Cygnus shines, just risen in the northeast, with Lyra above, Aquila to the right and Scorpio farther on toward the south. Arcturus, brightest of all the stars of distinctly reddish hue, shines almost overhead. Hercules and Boötes occupy a great space between him and the constellations previously named. Virgo is in the southwest, with Hydra below her. The stars lower down, which in our latitude rise but little above the southern horizon, belong to Centaurus, and observers in latitudes bordering on the tropics, or within them, will see below these the two bright stars of the constellation, the easternmost of which, Alpha Centauri, is our nearest neighbor in space. Leo is the most conspicuous group in the west, Gemini (now partly set) in the northwest, and the two Bears and Draco in the north.

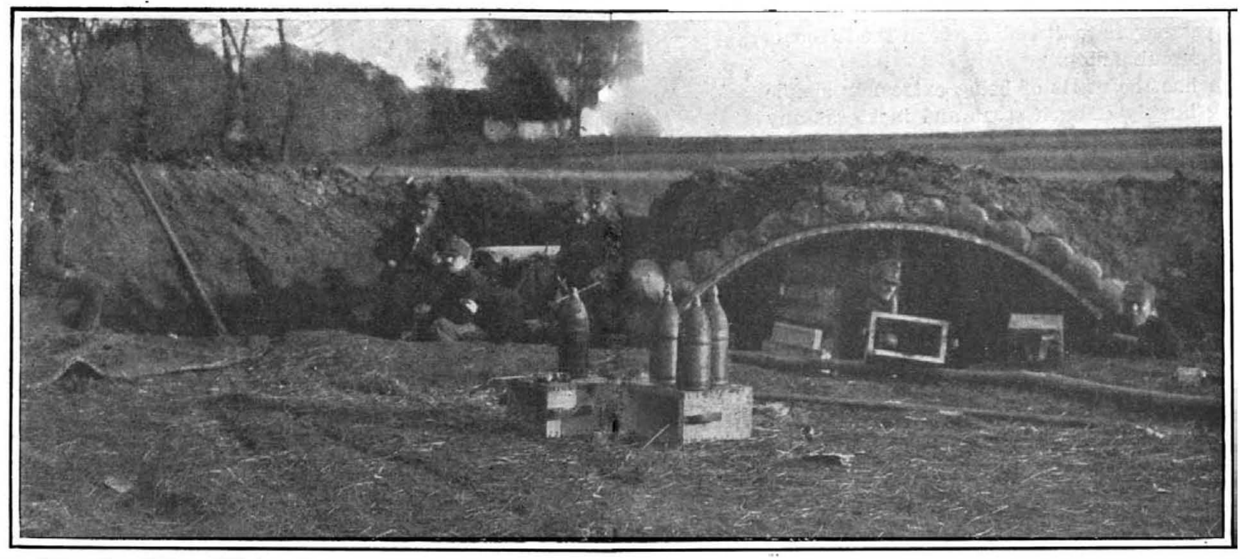
### The Planets.

Mercury is in conjunction with the Sun on the 1st, and thereafter is an evening star. During the latter part of the month he will be easily visible in the twilight, especially about the 31st, when he is at his greatest elongation. He is in the western part of Gemini and appears to be about as bright as Procyon, and superior to Castor and Pollux. Venus is a morning star, in Aries, rising about 3:30 A. M. and still very bright, although she is now 130 million miles from us. Mars is also a morning star, close to Venus. On the 14th the two planets are in conjunction, Venus being a little less than a degree to the southward. The difference in apparent brightness is very great, Venus seeming to us about ninety times as brilliant as Mars. There are several causes which combine to produce

(*Concluded on page 416.*)

Copyright by Brown & Dawson

A shipment of barbed wire to be used for German entanglements.



Photograph by Underwood & Underwood

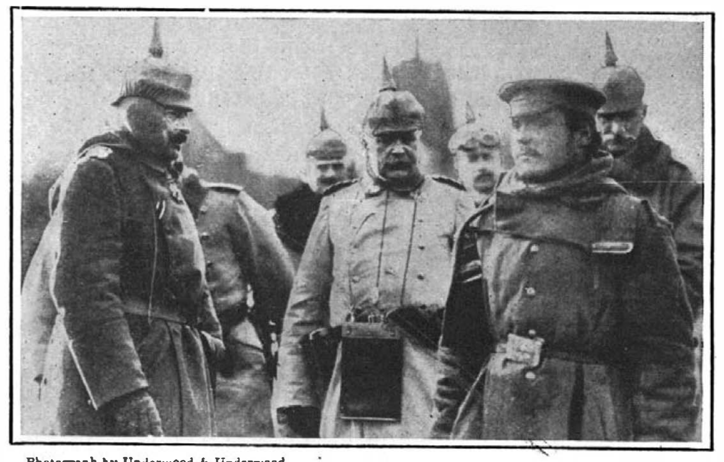
Austrian howitzer shells, showing the time fuses b which the moment of explosion can be accurately fixed.

Copyright by Brown & Dawson

The German army plowing for French peasants whose horses have been commandeered.

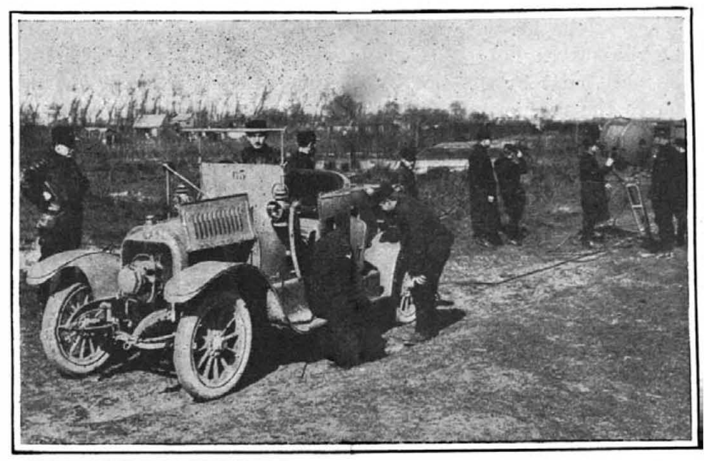
Photograph by Underwood & Underwood

British soldiers learning how to use the bayonet in trench fighting on the western front.



Photograph by Underwood & Underwood

The German Emperor on the eastern battle front cross-examining a Russian infantryman.



Photograph by Underwood & Underwood

Daylight signaling with a Bel an automobile searchlight outfit in nortl n France.

Copyright by Brown & Dawson

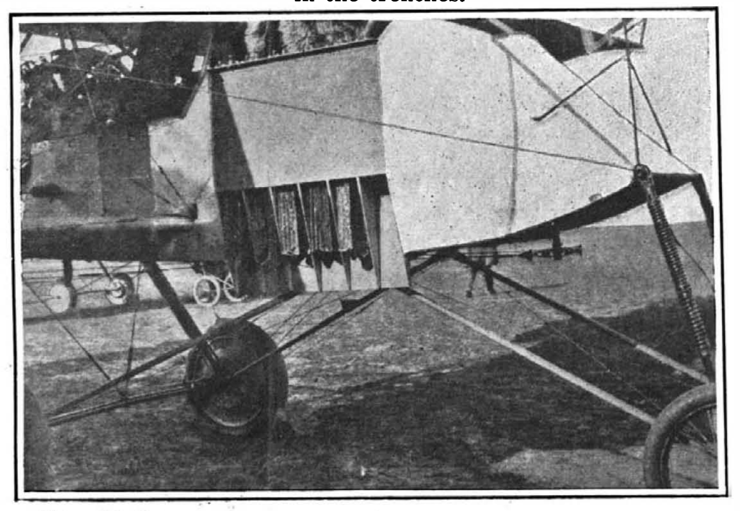
Printing a German paper (its name is "Hurrah") for the men in the trenches.

Copyright by Brown & Dawson

The Germans will not permit these Belgian girls to work in mines, to the detriment of their health.

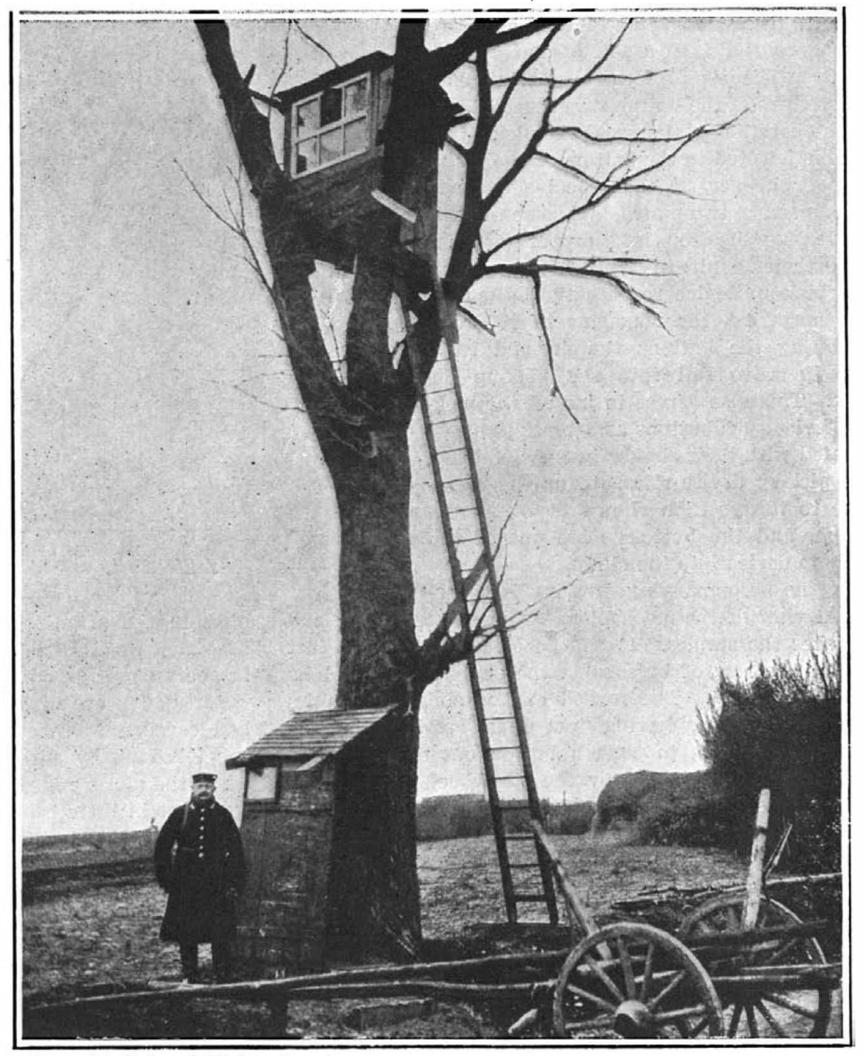
Photograph by Branger

English soldiers baling out of their trenches with long-handl scoops.



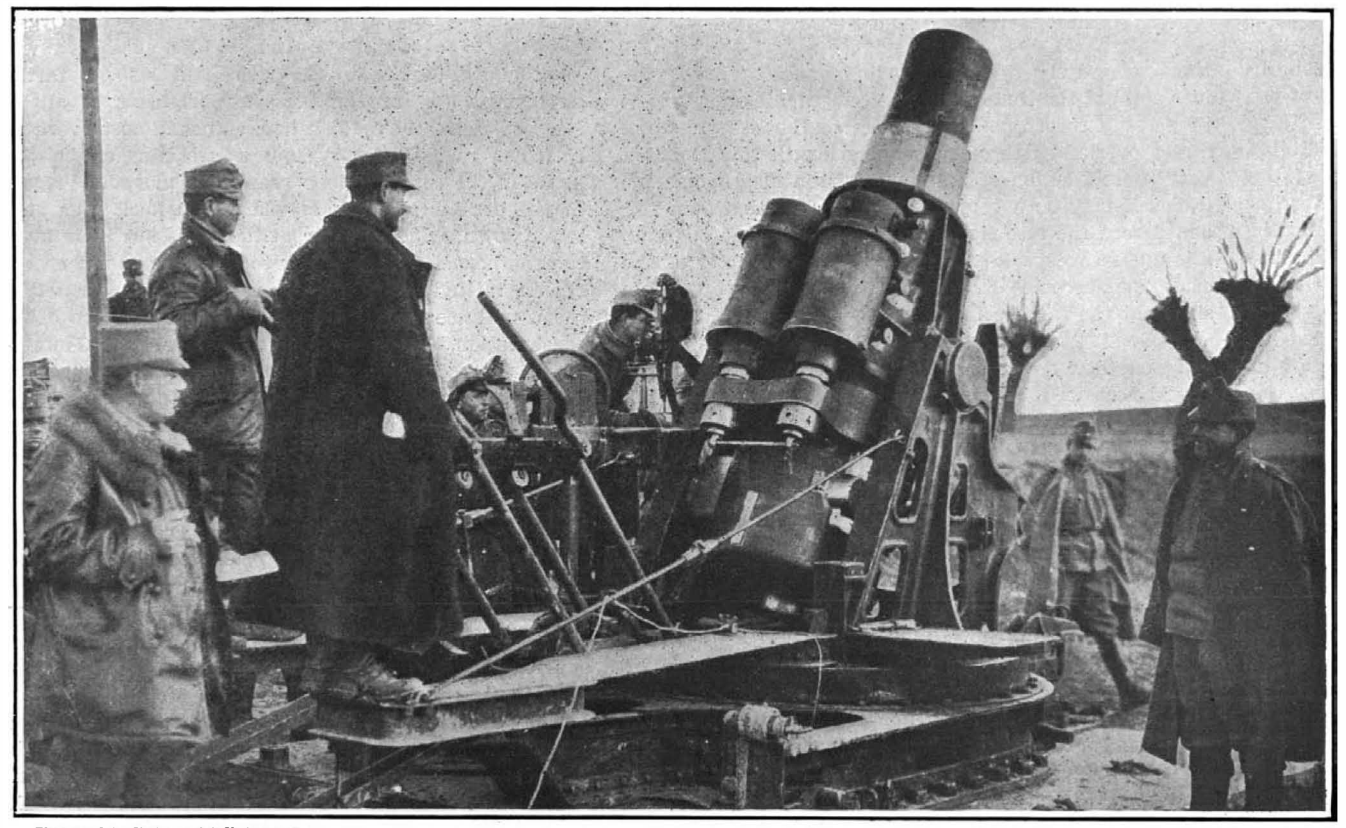
Photograph by Branger

A new bomb-dropping arrangement installed on a Voisin military biplane.



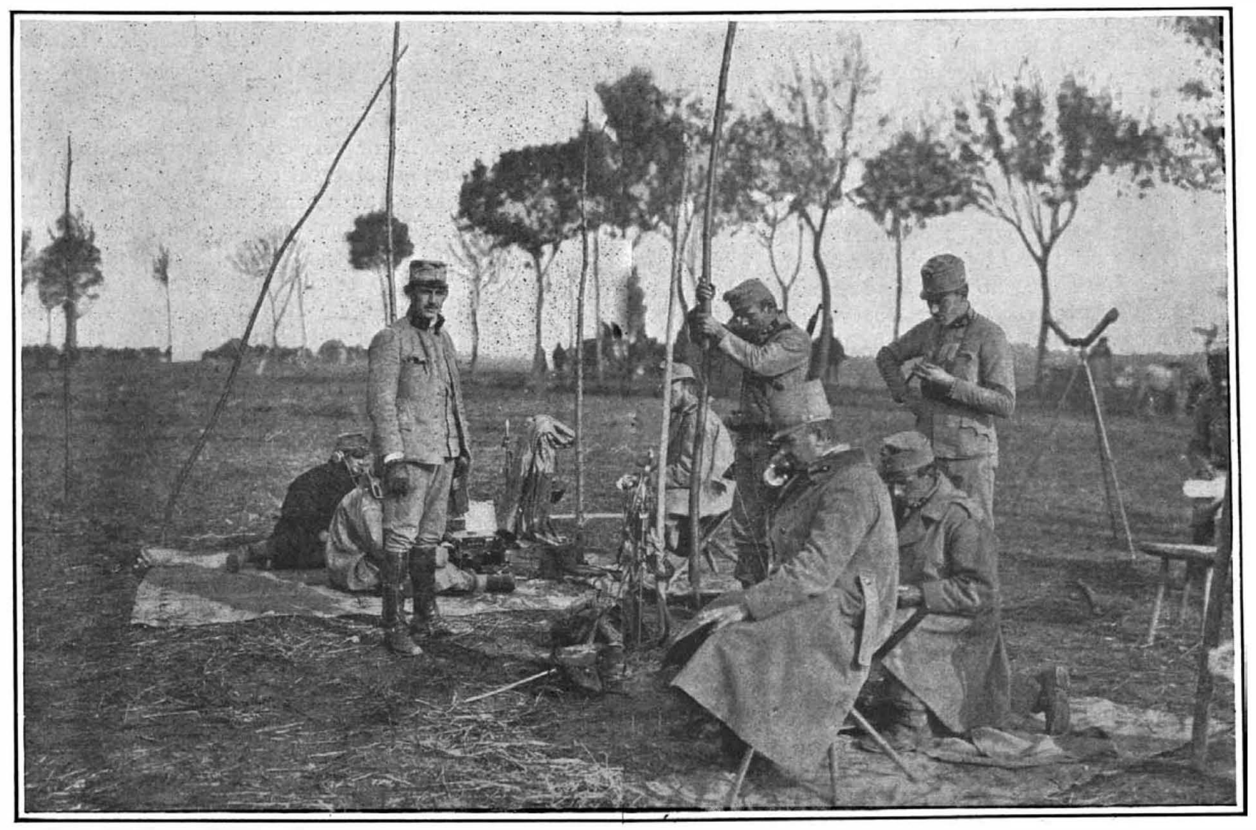
Photograph by Underwood & Underwood

To protect themselves from the inclement weather German soldiers have built tree houses from which they can observe the effect of artillery fire.



Photograph by Underwood & Underwood

The famous Austrian 30.5 Skoda howitzer, which has done wonderful work on the eastern and western frontiers.



Photograph by Underwood & Underwood

Austrian officers communicat by telephone with the firing line.

Photograph by Underwood & Underwood

This photograph, taken at Przemsyl, shows how the gun is lowered after it has been fired without exposing the crew.

RECENT PICTURES FR BOTH FIGHTING FRONTS

## Shoe-button Attaching Machine

A PATENT has recently been issued on a machine for attaching buttons with wire staples, which possesses many novel features and several improvements over present machines for performing this work. The new machine automatically makes, drives and clenches the staples, fastening the buttons to shoes, gaiters, leggins, and other articles. One of the advantages of the new machine is that it will take buttons of various sizes. If it be desired to attach a few buttons of a different pattern from those with which the magazine is stocked, the chute that leads from the magazine may be cleared by tilting it, so that the buttons will flow by gravity back into the magazine and then buttons of any desired design may be introduced into the chute by hand. The mechanism which feeds the wire to the staple-forming parts is arranged to operate only when there is a button in position to receive the staple.

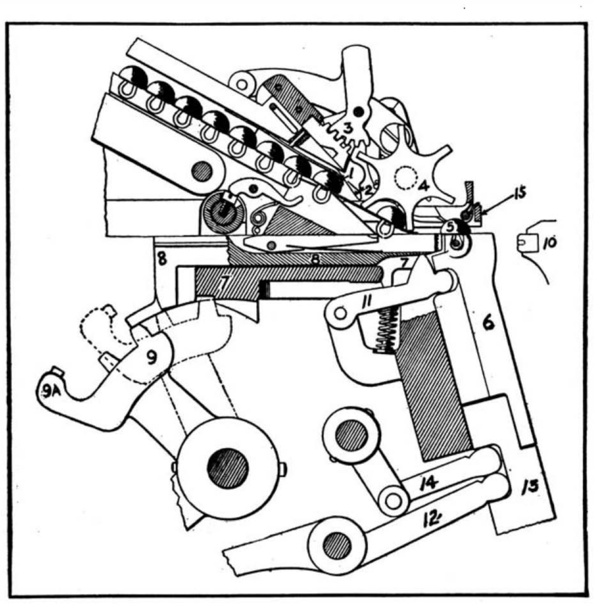
The accompanying photograph gives a general idea of the machine, and the method of using it to attach buttons to shoes. The machine is operated by depressing a pedal. In the magazine there is a pick-up device consisting of a pair of plates separated sufficiently to form a slot in which the shanks of the buttons are received. At each operation of the pedal the pick-up device is lowered to the bottom of the magazine or hopper, so that the buttons will fall upon the two plates, and some of them at least will drop into proper position, with their shanks in the slot. As soon as the pick-up device reaches the bottom of the magazine, the magazine itself drops, agitating the buttons therein and causing them to fall into the pick-up device. This also serves to jar off the pick-up device such buttons as are not properly located with their shanks in the slot. Then the pick-up device rises, lifting the magazine to the position shown in the photograph, and the buttons slide out of the pick-up device into the chute.

In the accompanying drawing is a sectional view of the mechanism which makes, drives and clenches the staples. It will be observed that the last one of the row of buttons in the chute is retained by a leaf spring 1. The forked ejector slide 2 is in its forward position, having just been operated by the mutilated gear 3, to push a button out of the chute. This button is detained by the starwheel 4, while the button 5 is being affixed to the shoe. The shank of button 5 rests in the staple former or die 6, and the wire has been threaded through the shank of the button. By mechanism not shown in our drawing, the wire is cut off to the desired length, and then it is bent forward to form a staple by means of a pair of fingers on the slide 7. These fingers, however, do not show in the drawing because the section is taken through the center of the slide, and the farther finger is largely concealed behind the staple driver 8 that operates between the fingers. The staple former is moved forward by the bell crank lever 9, which is actuated by the foot pedal. Further motion of this bell crank lever brings the extension 9A against the staple driver 8, causing it to push the button forward and force the staple point through the article to which the button is to be attached and against the anvil or clenching die 10. Of course before the staple driver can operate, the staple forming die 6 must be lowered out of its path. This is accomplished by means of a member 11, which engages the die 6. When the driver 7 is moved forward, it rides over the upwardly projecting tooth of member 11, depressing the member and with it the die 6.

Most of the mechanism that feeds the wire to the buttons is cut away in our sectional view. But the actuating lever may be seen at 12, also a slide 13 that it raises and lowers. The recess in slide 13 which the lever 12 engages is so large that the lever may swing through its full sweep without lifting the slide. But a filler is introduced into the recess in the shape of an arm 14, which is connected by a system of levers with the buttonholder 15, so that when there is a button in position to receive the wire, the buttonholder 15 is raised, introducing the filler 14 into the slide 13. Then when the lever 12 swings upward, it will lift the slide 13, and thread the proper length of wire through the shank of the button in the die 6. Should there be no button in the die, the arm 14 would be retracted, and the lever 12 would operate idly without lifting the slide 13. Thus no wire would be fed to the mechanism to cause clogging or imperfect working.

The inventor of this machine is Mr. Benjamin Kotkovsky of Brooklyn, N. Y.

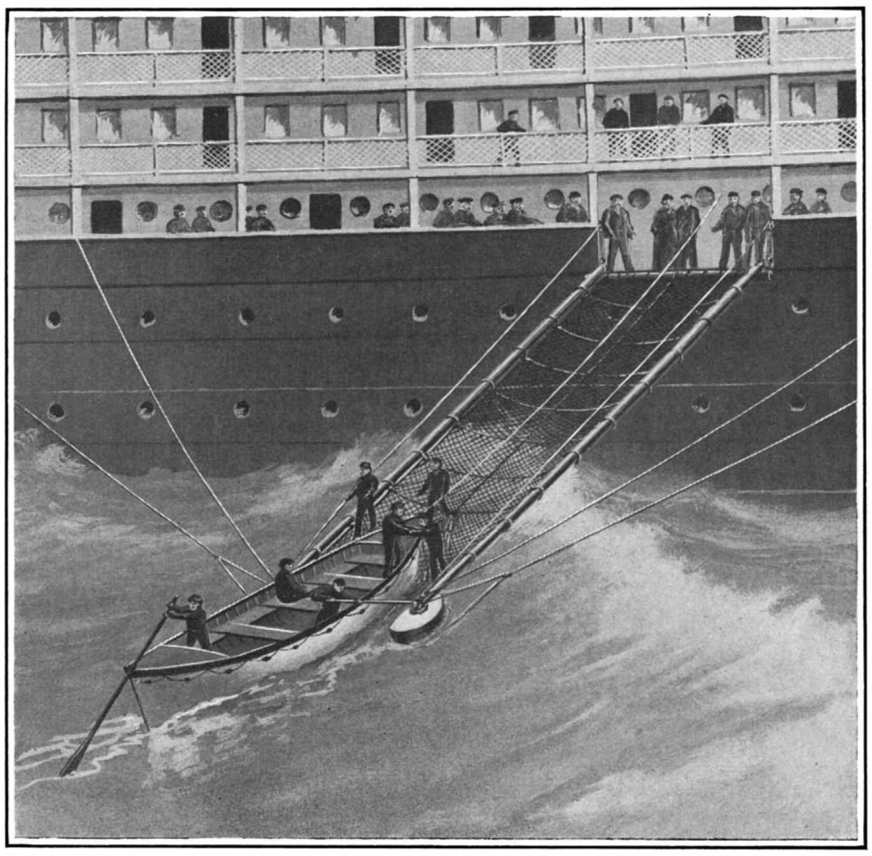
Attaching shoe buttons by machine.



Details of the driving and clenching mechanism.

## Emergency Marine Gangway

WHEN the ill-fated "Volturno" wallowed helplessly in mid-ocean, her terror stricken passengers huddled on the afterdeck to escape the inferno of flame that raged within her, there were plenty of would-be rescuers about, but they were powerless to reach these unfortunates owing to the high seas. Only those who had courage to throw themselves into the ocean and be picked up by a rescue boat had any chance at all while the storm raged, and then the daring sailors who went out in their lifeboats after these men and women had the greatest difficulty in disembarking the ship-wrecked ones from their lifeboats to their vessels. Not many were saved even in this way, and for long hours the ships stood about the wreck hoping that the sea would subside and give them a chance to deliver the unfortunate men and women.



Emergency gangway for embarking and disembarking passengers.

The ordinary method of lowering a lifeboat over the side of a vessel is attended with grave danger when a heavy sea is running, and it is not without danger even in comparative calm. Owing to the heavy load of a boat filled with passengers, and the great height of the boat deck above water, there is always the possibility that the boat may swing like a giant pendulum against the hull of the vessel and be crushed before it has a chance to reach the water.

Pondering upon these conditions, Capt. Arthur M. McGray has hit upon the scheme of using an inclined way, such as shown in the accompanying illustration, for the safe disembarking of passengers and crew from a ship in distress. The same device can also be used to enable the passengers to disembark from the lifeboats and board the rescuing ship.

This system has the merit of being extremely simple and consisting largely of such spars and tackle as any ship is provided with. Two booms are used of a length which will vary with conditions. They should be long enough to provide an incline of about 35 degrees from the water to the gangway. At the outboard end of each boom is a float large enough to buoy up the boom and make it ride on the surface of the water. These booms support a wire net which serves as a gangway down which the passengers and crew may make their way to the lifeboats. The booms are kept properly stretched apart by means of guy ropes as shown in the illustration. The network is provided with sufficient slack at the outboard end to permit the stem of the lifeboat to ride upon it. In this way the lifeboat may be held firmly moored to the rescue net.

Ordinarily a ship in distress lies in the trough of the waves, and the disembarking of passengers takes place on the leeward side. The action of the waves is then toward and from the ship, and by keeping the lifeboat bow-on to the rescue net it is in the best position to ride the waves. It will be noticed that the floats also are of such shape as to ride the waves best in this position, for they run parallel to the booms they support. The inner face of each float is flattened so as to clear the lifeboat. Of course the lifeboat will rise and fall on the waves, but so will the net, hence there will be no interruption to the embarking or disembarking of passengers. The booms are each provided with a set of rings and the net is readily attached to them by means of snap hooks. It is then drawn out to the end of the boom by means of suitable tackle. When not in use the net may quickly be removed, and the booms and boats together hoisted on board. With slight alterations the ordinary cargo booms of a ship may be utilized in this equipment.

Capt. McGray has recently secured patents on this life-saving apparatus, and he informs us that when he showed the invention to the captain of one of the rescue ships that took over a hundred people from the "Volturno," he said that it was the very thing he was trying to devise during those long hours of helpless watching, but he had not quite been able to figure it out.

## Using the Talking Machine to Teach Music

AS the result of a system of musical time-recording records for talking machines lately devised by Jules Louis-Elson of Far Rockaway, N. Y., the prospect of after-school practice hours on the piano stool may be lightened for juvenile music students. Mr. Louis-Elson's automatic "coach" will hold no terrors of scoldings or rapped knuckles for "young hopefuls," but will be found to be of infinite patience and ever-ready to repeat the count or an example of instruction.

The principles contained in what the inventor terms his "scenario" may be interpreted on six double-disk talking machine records, or, the same result may be obtained in a condensed form by combining all of the musical counting or time recording on one record only. In the latter case, the 1, 2 count runs in one endless groove, or circle, on the record; the 1, 2, 3, on an inner groove, and so on until the counting is complete with six separate circles on one record. This principle is applicable also in making two or three records of the six methods of musical time recording, or counting, if so desired.

On one side of the record are examples cited by the instructor in oral text; on the other side is the oral count of beats, as: 1, 2; 1, 2, 3; 1, 2, 3, 4, etc. A concluding specimen of the oral instruction text is as follows: "For example, let us take the Presto form (the record plays twelve bars). Now, when you consult the printed music you will notice that the quarter, or C (as it is printed), is barred. This serves to indicate that one should count in two. The record now sings as a teacher does the previously played bars of the Presto, emphasizing the count: 1, 2; 1, 2. Thank you."

## RECENTLY PATENTED INVENTIONS

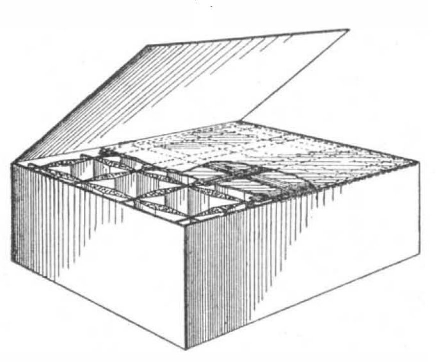
These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

### Electrical Devices.

TUNING TRANSFORMER FOR WIRELESS SYSTEMS.—R. R. GOLDTHORP, 204 High St., Hartford, Conn. This invention relates to a tuning transformer for wireless systems and relates more particularly to a transformer of that type having relatively movable primary and secondary coils in connection with means for varying the effective lengths of the coils to obtain a wide range of tuning capacity.

### Of Interest to Farmers.

FILLER FOR EGG CASES.—C. P. DALY, 2134 Amsterdam Ave., New York, N. Y. This invention relates to fillers for egg cases or carriers and more particularly to an improved double-walled filler of such construction that



FILLER FOR EGG CASES.

shocks incident to the shipping and handling of eggs or like fragile articles will not cause the breakage or injury thereto as is now commonly caused.

DESICCATING APPARATUS.—E. E. ELDREDGE, No. 2 Chevy Chase Apt., Chevy Chase, D. C. An object here is to provide a device by means of which milk or other similar fluids may be economically and effectually dried. The invention provides means for drying milk which will do away with complicated apparatus and which can be run continuously, thereby obviating the necessity of frequent delays for charging or discharging.

### Of General Interest.

DIAPHRAGM SETTING FOR PHONOGRAPH REPRODUCERS.—F. W. THOMAS, New City, N. Y. By this invention full tonal effects are obtained from the vibrations of the diaphragm and superior reproduction rendered possible, this through the use of reliable gaskets between which the peripheral edge of the diaphragm is clamped with a uniform and practically permanent compression, so that rattling of the diaphragm is positively prevented.

TOILET DISPENSING CABINET.—A. F. LESLER, care of Sanitary Co., 30 Church St., New York, N. Y. This invention provides a structure which may be used in a number of ways, and also used to dispense a number of different articles so that the device may be utilized in toilet rooms, lavatories and other places where toilet paper or towels are desired.

NON-REFILLABLE BOTTLE.—J. A. MATSON, 344 Greene Ave., Brooklyn, N. Y., N. Y. The inventor provides a bottle with a cup in its neck and having a central valve opening in which is normally disposed a plunger with a stem disposed in a central opening, in a guide having lateral openings through which the liquid may flow from the bottle and air may flow into the bottle to replace the liquid which has flown therefrom.

AMALGAMATOR.—J. C. WOOD, care of E. N. WOOD, 1156 Monadnock Bldg., Chicago, Ill. This invention relates to improvements in amalgamators, and has for an object to provide an improved structure for causing the gold or other mineral matter to be separated while the aggregating matter is moving continually through the device.

HAIR TRANSFORMER. — J. J. TEUGLER, 1523 Sherry St., Philadelphia, Pa. The invention relates to hair dressing, more especially false hair, and the main object thereof is to provide a transformer for women's hair, whereby the entire head-dress may be placed in position or removed therefrom, as a unit.

### Hardware and Tools.

MOWER.—G. P. HELFRICH, 976 Fox St., Bronx, N. Y., N. Y. This mower cuts with a single knife blade. It will cut grass of any height, and also cut close to a wall or fence. There being no friction between blades, the mower will cut a wider swath than other mowers, with the same amount of power.

POT AND COVER LIFTER.—K. PROCHASKA, care of Berthold Lechner, 25 W. Broadway, New York, N. Y. The invention relates to tools for use more particularly in connection with cooking utensils or camping outfits. It provides an implement of cheap and strong construction, the same being provided with various engaging devices at its ends whereby the implement is adapted for numerous various uses.

DENTAL ENGINE TOOL GUARD.—F. F. FISCHER, care of Dr. C. Myron Kaletsky, 297 Fulton St., Jamaica, N. Y. Among the principal objects which the present invention has in view are: To provide a guard arranged to prevent the contusion of flesh between the said guard and the abrasive tool; and generally, to provide a guard and holder therefor having a compact structure and a neat appearance.

WIRE STRETCHER.—A. B. DILL, Lakin, Kan. The invention relates to wire stretchers and the object is to provide a device of this character which is light and compact, which may be readily set up and taken down before and after the stretching operation, and which will be effective and durable in use for the purpose it is intended.

CARPENTER'S TOOL.—W. H. BARRON, JR., and C. LESEMAN, 203 N. Arizona Ave., Atlantic City, N. J. This improvement relates to tools for the use of carpenters, stair builders, cabinet makers and others, and the main object is to provide a tool which is adapted for a wide range of use as a marking gage, and also as a scriber, to mark work on regular or irregular lines.

### Heating and Lighting.

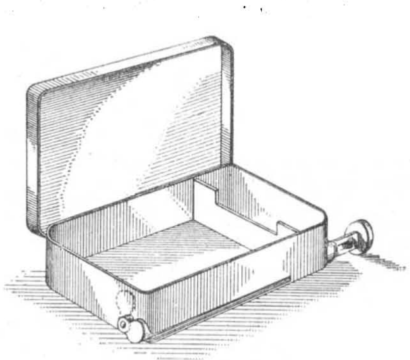
AIR FEED FOR FURNACES.—E. WINANS, New York, N. Y. This structure may be readily inserted into furnaces for supplying the heated air thereto so as to cause a better combustion of the gases evolved from the gases in the furnace. The air feeding device may be built into the furnace or may be added to the furnace at any time.

### Household Utilities.

WATER CLOSET.—F. SCHUH, 25 Jarvis Ave., Trenton, N. J. The improvement provides a closet arranged to combine the bowl and tank in one single integral structure, to render the closet exceedingly sanitary, to avoid leakage, to insure an effective flushing of the bowl and drainage of the accumulated moisture or overflow.

### Machines and Mechanical Devices.

CIGARETTE ROLLING MACHINE.—J. E. ROACHE, 91 Clinton Ave., Brooklyn, N. Y., N. Y. The object of this invention is to provide a machine arranged within a tobacco container to allow the production of a cigarette without danger of spilling the tobacco, to permit of placing the proper quantity of tobacco

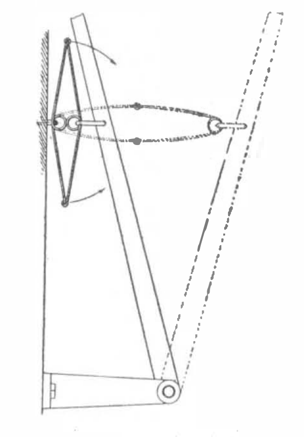


CIGARETTE ROLLING MACHINE.

into a forming or filling tube, to uniformly distribute and pack the tobacco in the said tube, to wrap the wrapper around the tobacco in the filling tube, and to allow of finally ejecting the finished cigarette from the tube without requiring opening of the container.

VARIABLE SPEED GEARING.—P. D. SMITH. Address Francis G. Wilson, 140 Pacific Ave., Santa Cruz, Cal. The invention relates more particularly to a gearing adapted to automobiles and other machinery, and provides means whereby rotation may be transmitted from a driving to a driven member at a variety of speeds ranging in a driven member from a revolution for every revolution of the driving member down to a standstill when the driving member is at full speed.

SPRING.—F. C. GIVENS, Tuolumne, Cal. This invention has reference to springs, particularly to extensible springs having a contractile effect, and one of the main objects thereof is to provide such springs which allow



SPRING.

extension up to a definite point, but beyond which will result in breakage of the parts. The invention provides such springs which will always return to initial position when relieved of tension.

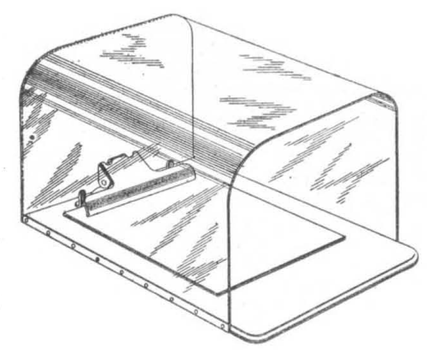
GRINDING MILL.—F. T. H. GOODWIN, Erskine House, Longton, Stoke-Upon-Trent, England. The object here is to provide means for the grinding or milling of potters' and like materials whereby the same are prepared for the manufacture of, for instance, pottery. The feeding of the material and the water is regulated to suit the rate of outflow and the degree of fineness to which the material is to be ground and the required fluidity of the slip or the ground and mixed product.

AUTOMATIC DOOR OPENING AND CLOSING APPARATUS.—G. M. BEERBOWER, 75 Harmon St., Pelhamwood, N. Y. The invention has reference to an opening and closing apparatus for doors or gates of that type whereby the door or gate automatically opens upon the approach of a vehicle and automatically closes upon the departure of the vehicle.

AUTOMATIC STUFF BOX FOR PAPER MACHINES.—W. P. FEENEY, 32 Elm St., Hudson Falls, N. Y. The invention provides a stuff box for use in paper machines having means actuated by a float for regulating the flow of the stock to a paper machine and for returning the surplus stock to the chest. Means provide for returning the stock to the chest before it reaches the float.

### Railways and Their Accessories.

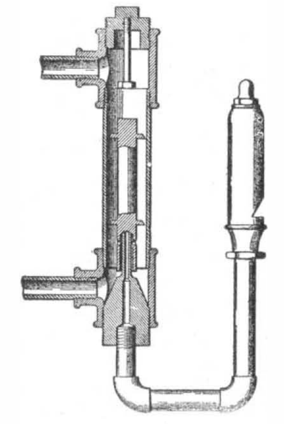
CLIP BOARD SHIELD.—J. A. LEE, P. O. Box 194, Brigham, Utah. The invention provides a transparent shield and covering adapted for attachment to a clip board, that is to say, to a base provided with a clip. By a clip board, it is to be understood, is meant



CLIP BOARD SHIELD.

any equivalent base having means to hold paper to be written upon. It is particularly applicable to a clip board for holding a conductor's train book, or a yard checker's train sheet or the like, while checking trains in the rain, snow, or wind.

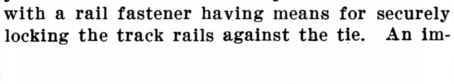
AIR SIGNAL VALVE.—E. J. ERICSSON, 1352 Guerrero St., San Francisco, Cal. This inventor provides a valve in the train signal air line which permits the actuation of a signal when a relief valve at one of a plurality of points is opened, said signal preferably being in close proximity to a locomotive engi-



AIR SIGNAL DEVICE.

neer or to a motorman of a motor car or train. The valve prevents the signal actuation when the train line is closed, regardless of the pressure of air in the train line. The valve permits the actuation of the signal of a portion of the air rushing from the air reservoir to an open relief valve.

RAIL TIE AND FASTENER.—W. A. GUPTILL, Maidstone, Vt. One of the principal objects of the invention is to provide a cross tie with a rail fastener having means for securely locking the track rails against the tie. An im-



RAIL TIE AND FASTENER.

portant object is to provide a fastener adapted to clamp the tie so firmly to the rail that all vibration will be reduced to a minimum, and also to provide means for taking up wear between the fastener and rail.

### Prime Movers and Their Accessories.

INTERNAL COMBUSTION ENGINE. — J. KEISTER, Steubenville, Ohio. The invention relates to engines of the four-cycle type, and particularly to engines of that character wherein the admission of the explosive fluid and the exhaust of the spent gases are controlled by a single tubular valve which surrounds the piston of the engine.

METALLIC PACKING FOR PISTON RODS. —J. BADEKER, care of Omaha Machine Works, 612 South 14th St., Omaha, Neb. This inventor provides a packing which will not require the numerous repairs that are necessary in the ordinary packing of this type, but which will continue to work efficiently without the necessity of repair until such time as is necessary for replacing all the packing itself.

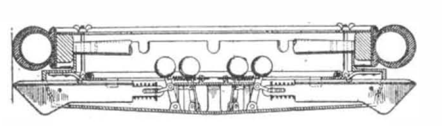
INTERNAL COMBUSTION ENGINE.—F. D. CALKINS and A. C. JOHNSON. Address Gray Motor Co., Detroit, Mich. The invention has for its object the provision of means in connection with a rotary valve for controlling the admission and exhaust of the motive fluid, for holding the valve yieldingly on its seat, while permitting it to rotate, and for compensating for wear in the valve or in the seat.

### Pertaining to Recreation.

GAME.—G. B. SMITH, Waldwick, N. J. The invention relates particularly to a game adapted to be played by a number of players; and provides an arrangement whereby all of the players have an equal chance but where an unwise move by an opponent will be liable to produce disastrous consequences.

### Pertaining to Vehicles.

ATTACHMENT FOR AUTOMOBILES.—F. R. NYBERG, 104 North 8th St., Lamar, Col. This improvement is designed to be attached to the wheels, and wherein a housing is provided capable of attachment to and removal from the wheels and carrying a series of dogs



ATTACHMENT FOR AUTOMOBILES.

arranged in spaced relation and mounted for movement beyond the periphery of the wheel and normally lying within the periphery of the wheel, and wherein other mechanism is provided in connection with the dogs for extending the dogs at predetermined times.

SPRING WHEEL.—G. J. MURPHY, Baradero, Buenos Aires, Argentina, S. A. The invention relates to a spring wheel adapted for use on automobiles and other vehicles, and more particularly relates to a wheel in which the tire section is in the form of an annular spring coil, there being a separate hub section and spoke elements to form a connection between the hub section and the coiled spring tire.

BRAKE BLOCK HOLDER.—P. KRUEMLING, Maher, Colo. The invention relates to a holder for brake blocks or shoes, and the object thereof is to provide a device of this kind, which will permit of the utilization of any kind of a block to form the brake shoe, and which can be readily mounted upon the beam by means of which the brakes are applied.

### Designs.

DESIGN FOR A CLOCK FRAME.—J. E. STEINMEIER, Address C. H. Osborne, care Western Clock Co., 375 Broadway, New York, N. Y. In this ornamental design for a clock frame the frame is upright in form and outside the dial the effective features comprise cupids, scroll work, and flowers.

DESIGN FOR A DOLL.—CLAIRE AVERY, 232 E. 15th St., New York, N. Y. In this ornamental design for a doll the figure lacks arms and legs. A plain baby face is surrounded by a neat shaped head covering capped by a bow, and a dress with a single flounce hangs from the doll's neck.

DESIGN FOR A PARASOL.—O. M. ARNOLD, care of Arnold, Schiff & Co., 85 Fifth Ave., New York, N. Y. In this ornamental design for a parasol, the article has a long, graceful handle and rod; on the latter is a frame of very graceful form, its cover ornamented with a highly original flounce effect.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

## Notes and Queries

Kindly keep your queries on separate sheets of paper when corresponding about such matters as patents, subscriptions, books, etc. This will greatly facilitate answering your questions, as in many cases they have to be referred to experts. The full name and address should be given on every sheet. No attention will be paid to unsigned queries. Full hints to correspondents are printed from time to time and will be mailed on request.

(13056) G. C. A. asks: What is the mechanical equivalent of light? That is, is the candle-power a measure of energy or merely a measure of comparative brilliance? In the latter case, what is the unit of light energy, and what is its mechanical equivalent? What is the latest theory of light? What, if any, is the relation between light and electricity? What is the relation between the static units of electricity and the electromagnetic units? What is the latest generally accepted theory of electricity? A. The candle-power is a measure of brilliancy. It is by law in America the amount of light given by a candle burning 120 grains of wax per hour. They are made six to the pound. There is no mechanical equivalent of light in the same sense as there is a mechanical equivalent of heat. The same amount of power does not always yield the same amount of light. The efficiency of an arc light is much greater than that of the incandescent lamp, and so of other illuminants. The accepted theory of the nature of light is that it is an electromagnetic phenomenon. It is transmitted from the sun to the earth by the agency of the ether of space. This is known as Maxwell's Electromagnetic Theory of Light. The ratio of the electrostatic to the electromagnetic units is a velocity, and it appears to be the velocity of light, as it should be if Maxwell's theory is correct. For this interesting topic we would suggest Thompson's "Elementary Lessons in Electricity," which we can send for $1.40 net, postpaid $1.55. The Electron theory is now generally accepted as best explaining the phenomena of electricity. You will find a simple explanation of the electron theory in our SUPPLEMENT 1861,

(13057) C. C. S. asks: Kindly answer under Notes and Queries the following: A asserts that there is nothing that will change its real essence by a change in its degree. B says things will. Who is right? A. In a general way, a difference in degree can be made to disappear by an increase or diminution of the kind of thing involved. If a reasonable profit is right an enormous profit is wrong, and the larger the profit beyond reason the greater the wrong. The difference here between right and wrong can be removed by diminution till the wrong has disappeared. The difference in degree between a rich man and a poor man can be made to disappear by the addition of money to the poor man's bank account. A difference in kind cannot be made to disappear by addition or substraction. A mountain cannot become a river by any change in degree, while a large mountain can be made into a small mountain by taking earth away from it. These illustrations will convey the essential difference between the two terms difference in degree and difference in kind.

(13058) H. F. W. asks: As a regular reader I would be glad if you would kindly tell me about the bright star visible in the southeast in the early morning in this locality. I am told it is the Star of Bethlehem and that its appearance indicates some important event is about to occur upon the earth, and that its past history has borne this out. A. The bright "star" in the southeast in the early morning hours is the planet Venus on her regular course around the sun. She is quite unconscious of the interest her appearance awakens and is entirely disconnected with the Star of Bethlehem. She comes into this position at this hour of the night with regularity and her appearance does not portend anything whatever with regard to the earth or its history.

(13059) H. C. B. asks: During a recent experiment, in which I was using mercury in a glass vial to make an electrical contact in a circuit, I was at a loss to account for the presence of mercury on the bench beneath the switchboard. In order to prove where this leakage was coming from I was finally obliged to remove the vial and contacts until I made the experiment as shown on rough sketch here inclosed. I have proven that the mercury creeps up the copper wire and drops from its end as if it were a wick. In this experiment there is no electrical circuit and no other condition except those as shown. Can you tell what causes this condition and how to avoid it? A. We have tried the experiment with a clean copper strip and a copper wire in mercury, and have not been able to produce any climbing of the mercury up the copper. If there is any such action, it is due to capillarity. Mercury might climb clean copper, but we do not know how high it would go. It would climb a cable of twisted wire much better than a single wire or a flat strip.

(13060) R. W. L. asks: In the absence of a question column, I am sending this communication to you in the hope that it will be answered by means of the inclosed envelope. For over a year I have been trying to get some complete information regarding the element seienium. I want to know how the selenium cell is made, in order to perform the experiments where its electrical conductivity varies with changes in light. I have inquired at the university (where I am a student) and looked it up in the physics library, but have been unable to learn how these cells are made. I have come to the conclusion that the SCIENTIFIC AMERICAN would know if anyone does, and I certainly would appreciate anything you could tell me on this subject; either the information itself, or where such information could be secured. A. We have published many articles about selenium and its uses. Among them have been several giving detailed plans for making selenium cells. You will find these in our papers as follows: SCIENTIFIC AMERICAN SUPPLEMENT Nos. 1430, 1719, 1912, 1881, 1882, 1883, 1897, 1914, 2041, 2046, and the SCIENTIFIC AMERICAN Vol. 107, No. 21, and Vol. 112, No. 9. You will find the information in these papers complete.

(13061) E. E. H. asks: 1. How are scales made and circles graduated? I wish to graduate a circle for amateur use of a telescope, accurate enough for finding such objects as the telescope can enable me to see. A. The graduation of a scale, either on a straight edge, or a circle, is best done by means of a screw, as perfect a screw as can be constructed. The surface to be ruled is moved under the graving point, or the point over the surface, usually the former, and the graduations cut in one at a time. If the screw has 10 turns per inch, and the disk upon the head of the screw is divided into 100 equal parts, a complete turn of the screw moves the graving point along 1/10 of an inch, and turning the head around one division moves the graving point 1/100 of 1/10 of an inch, or 1/1000 of an inch. In this way any desired scale can be graduated on a bar. A circle is divided into degrees by means of a circle upon the outer edge of which gear teeth are cut. A screw meshes into these teeth. The screw is turned enough to move the circle 1/360 of its circumference, if the degrees are to be cut in the circle to be graduated. A line is graved with the graving point, and the process is continued till the work is finished. The accuracy of the whole depends upon the accuracy of the screw. The Ency. Brit. 11th edition, vol. xii, pages 312-314, contains a very clear account of the development of the Dividing Engine, with a cut of one. You may perhaps graduate a circle well enough for your purpose by first dividing it into quadrants, and then into eighths by bisecting the quadrants. The sections of 45 degrees can be divided into thirds, or 15 degrees, and these into thirds, or 5 degrees. Then you can divide these sections into single degrees and half degrees. In this way there will not be so much accumulation of errors as there will be if you try to space off a large section of the circle into a single degree with dividers. 2. How are verniers constructed? A. You can make a vernier to read to one minute for your circle by taking 29 half degree spaces of the circle and dividing this space into 30 parts for the vernier. The vernier will then read to one minute. By making 30 vernier spaces equal to 29 scale spaces, each vernier space is 1/30 of a scale space shorter than a scale space. The scale division is a half degree, or 30 minutes, and the vernier division is 29 minutes or one minute shorter than the scale division. With such a vernier readings to one minute of arc can be made. The vernier is fully described in the Ency. Brit. 11th edition, vol. xxvii, page 1032, so far as straight lines are concerned, and we have given a description of a vernier for a circle. We trust this will clear up some of your difficulties. 3. How can a ball fall to the east of the point from which it is dropped when the text books say it will fall toward the center of the earth? A. Your doubt as to the fact of balls falling to east of the point from which they are dropped has been answered in Query 13054, issue of March 20th, 1915. The earth does not turn under the ball as it falls. By inertia the ball retains the eastward velocity of the point from which it started, and as it falls to a place which is rotating slower, it will be moving faster to the east than the place to which it has come. For this reason it falls toward the east. It is not the same with an ordinary balloon which moves with the air and has only the motion of the earth and the air to give it motion. It simply floats with the wind, and has no power to move itself. It has simply the velocity of the place where it happens to be. A ball dropped in a car falls perhaps six feet. In that distance there is no visible deviation. Several hundred feet are necessary to produce a measurable deviation. If the earth turned under a balloon it would leave the balloon to the west of the place from which it started since the earth turns toward the east and the ball in falling turns to the east faster than the earth does at the level to which it has fallen. We hope this is clear. 4. Why do races living in hot climates have black skins if Nature protects them from heat? A. The question of black people in the Torrid, and white polar bears in the Frigid Zone, is perhaps not simply one of absorption of heat. Black is also the best color to radiate heat, hence the black man is able to get rid of his heat to the highest degree. There is probably much more to it than this. The annoyance and injury from excessive light is probably due more to the ultra-violet rays of the sunlight than to the heat rays. The black pigment of the negro is a defense against these rays. The white man who migrates to the Torrid Zone in a few generations develops a dark pigment which adapts him to live under torrid conditions. There can be no doubt that adaptation to environment has brought about the condition and that the black pigment is an advantage and not a detriment to the people in whom it is developed.

## NEW BOOKS, ETC.

ANIMAL EXPERIMENTATION AND MEDICAL PROGRESS. By William Williams Keen, M.D., L.L.D., Professor Emeritus of Surgery, Jefferson Medical College, Philadelphia. With an Introduction by Charles W. Eliot, LL.D., President Emeritus of Harvard University. Boston and New York: Houghton Mifflin Company, 1914. Price, $1.75.

Dr. Keen has been one of the ablest champions of what is improperly called vivisection. He has done his share in spreading among the multitude the truth about animal experimentation and the great benefits that scientific men and humanity have derived from the use of the lower animals in the laboratory. The book is a series of papers which have been published by Dr. Keen in medical and other journals and which are here arranged in chronological order. If there is much repetition as a result of the author's desire to reprint the papers exactly as they appeared, there is also much force in his argument that "a potent reason for the repetitions is that they were intended to meet the constantly repeated misstatements by the opponents of experimental research in spite of public exposure of these misstatements." To those who wish an exposition of the unreasonableness, inaccuracy and indifference to truth and justice manifested by anti-vivisectionists, this book may be heartily recommended. Coming as it does from an eminent surgeon and a man of humane feelings it should be read by everyone who takes any interest whatever in the present campaign to restrict scientific men in their efforts to relieve the sufferings of humanity.

THE NEW BUSINESS. By Harry Tipper, President, Advertising Men's League, New York. Published by Doubleday, Page & Co. for the Associated Advertising Clubs of the World. 1914. 8vo.; 391 pp.; illustrated. Price, $2 net.

The author confesses that commerce has always held for him the interest which attaches to a great primary force. It is probably this attitude which, taking possession of his pen, injects an almost breathless suspense into his work. Yet here is no popular tract on the romance of this, that, or the other. Any man of fair intelligence may understandingly absorb its facts, but these go to the very heart of advertising, marketing, selling—and back their statements with concrete examples. There is a short review of the old conditions of hand labor; then a sketch of modern conditions which followed upon the advent of steam. The second section of the work deals with finance and marketing costs, including a study of the concentration of money control and its effects. Section 3 takes up the factors in marketing cost. Sections 4 and 5 bear upon organization, training, and specializing. The final division concerns itself with good-will, with buying habits, and with future tendencies. The author has prepared graphic charts which place vital facts and phases of manufacturing, distribution, and competition before the reader.

THE CHEMISTRY OF FAMILIAR THINGS. By S. S. Sadtler. Philadelphia: The J. B. Lippincott Company, 1915.

This book differs markedly from the usual popular presentation of chemistry. It begins originally enough, not with the usual cut-and-dried elementary exposition of chemical principles, but with the part that chemistry has played in nature. Not until the natural aspect of the subject has been dismissed and the importance of an exact knowledge of the composition of matter pointed out, are such subjects as atoms and molecules, acids and organic and inorganic substances discussed. Nor is the book confined entirely to chemistry. The chapter which is entitled "The Chemistry and Production of Light" is very largely a discussion of physical principles and takes up subject matter which properly falls within the scope of this book, but which most chemists would probably omit. Chemistry and physics are nowadays so intimately interwoven that it is difficult indeed to exclude physics from a popular text-book on chemistry. Generally we find heat combustion, insulation, air, oxidation and ventilation taken up not only from the chemical but from the physical standpoint. The range of the book is wide indeed. The chemistry of the earth's evolution, soil and its conservation, food elements and food classes, animal feeding, fermentation, chemistry of the body, paper and textiles, leather and rubber, silicious substances in glass—all these find a place in the book. Taken as a whole the book may be regarded as a good example of what popular scientific writing should be.

THE CURVES OF LIFE. Being an Account of Spiral Formations and Their Application to Growth in Nature, to Science and to Art. With Special Reference to the Manuscripts of Leonardo da Vinci. By Theodore Andrea Cook. With 11 plates and 415 illustrations. New York: Henry Holt & Co., 1914.

It is difficult indeed to describe the impression which is left upon the mind by this remarkable treatise. The book of nature is opened at a new page, as it were, and a new chapter is presented for perusal. This is not the work of a mystic but the fruition of twenty years' study of spiral formations as they are exhibited in shells, plant leaves, seeds, crystals, clouds, tendrils, animal horns, the cochlea of the human ear and the umbilical cord, bones, the intestines, fingerprints, the muscular fibers of the heart, nebulæ, and the artistic works of great painters and sculptors. The underlying cause of beauty in art and in nature is found to be the same—found to be the logarithmic spiral. With the assistance of Mr. Mark Barr and Mr. William Schooling, these spiral formations have been considered mathematically. It seems that the spirals are generally of one type, and that their form is closely connected with the geometrical series 1, $\phi$, $\phi^2$, $\phi^3$ ........ $\phi^n$. In this the quantity $\phi$ is such that the sum of any two consecutive terms is equal to the next. Thus considered, $\phi$ must be equal to 1.618033... or −0.618033.... It is amazing how generally applicable is this formula to works of art, such for example as "The Laughing Cavalier" by Franz Hals, the "Venus" of Botticelli, the "Last Supper" of Leonardo, the "Ulysses Deriding Polyphemus" of Turner, and even to some of the works of Burne-Jones. Apparently the logarithmic spiral, judging from the numerous examples quoted from nature by Mr. Cook, is the nearest mathematical expression we can use for the relation of form to growth. The idea of logarithmic spirals as applicable to growth did not originate with Mr. Cook, as he clearly admits. We find it, for example, in Mr. A. H. Church's discussion of Phyllotaxis. The critique of the "Life-labored Utterances of Passionate Thought" of Leonardo da Vinci is one of the most eloquent and sympathetic that has ever come to our notice. Indeed, the whole spirit of Leonardo dominates the work. Written in clear graceful English with a delightful personal touch, the book is a pleasure to read.

ELEMENTARY ELECTRICITY AND MAGNETISM. A Text-book for Colleges and Technical Schools. By William S. Franklin and Barry Macnutt. New York: The Macmillan Company, 1914. 12mo.; 174 pp.; illustrated. Price, $1.25 net.

ADVANCED THEORY OF ELECTRICITY AND MAGNETISM. A Text-book for Colleges and Technical Schools. By William S. Franklin and Barry Macnutt. New York: The Macmillan Company, 1915. 8vo.; 300 pp.; illustrated.

The first text-book is an elementary presentation of the magnetic, chemical, and heating effects of the electrical current, of the conditions and phenomena of induced electromotive force, and of electric charge and the condenser. The argument is energetic, the diagrams simple, and the examples practical. This general description also applies to the "Advanced Theory of Electricity and Magnetism," which carries the student over the same general field, but to a wider and deeper purpose, with amplified detail. It has a chapter on ship's magnetism and the compensation on the compass. It treats extensively of the electric field, the theory of potential, and electric oscillations and waves. Its final section is devoted to the electron theory, which in the table of contents is referred to, by an unfortunate typographical error, as the "election theory." The authors are experienced in the writing of school texts, and their work is sound, well-planned, and adapted to inspire and energize the immature intellect.

ADVERTISING. Selling the Consumer. By John Lee Mahin. Published by Doubleday, Page & Co. for the Associated Advertising Clubs of the World. 1914. 12 mo.; 260 pp.; illustrated. Price, $2 net.

In so often encountering the phrase "It pays to advertise," we are prone to overlook the fact that nothing is more costly, more wasteful, than ignorant and indiscriminate advertising. Advertising is an art and a science, as no one knows better than Mr. Mahin, and few are better qualified to impart its principles and its technique. His book admirably covers the general field. It sketches the present status of the science and states its fundamental problems. It shows exactly how markets benefit both producer and consumer, and how salesmanship is related to advertising. The fact is clearly elucidated that buyers may be divided into groups according to their incomes, and that the important question is how to reach the required group. The tools of advertising, its mediums, and the tests of its merits are convincingly discussed, and the various forms, retail, mail-order, and national, are separately handled. Many other phases of the subject are touched upon in the closing chapters, and so concrete is the information offered, so practical all the teachings and advice, that in reading the volume one seems to have his finger upon the very pulse of trade.

MODERNE NATURPHILOSOPHIE. Von Wilhelm Ostwald. Leipzig: Akademische Verlagsgesellschaft, 1914.

More than ten years have passed since Prof. Ostwald published his lectures on natural philosophy, which created a profound impression at the time. It is but natural that since their publication the author's views should have undergone some change. Moreover, scientific advances have also been made within the last decade which could not be ignored in an attempt to whip our modern scientific philosophical conceptions into a natural philosophy such as that with which our forefathers were familiar. Indeed, the whole scheme of presenting a modern natural philosophy has so far developed, that this new work promises to be the first of a whole series of three volumes. In this first volume Prof. Ostwald discusses the modern concepts of logic and mathematics. In other words, concepts which have nothing whatever to do with energy, as such, and which he places under the term "Ordnungswissenschaften." Prof. Ostwald regards logic as the first and most general science, and the greater part of his lectures is devoted to driving home that truth. Prof. Ostwald is probably one of the best men living to write a work on modern philosophy. A distinguished scientist who has made valuable contributions to chemistry in his day, an intellect which has almost dominated certain phases of modern German scientific thought, his work bids fair to form the basis of a whole literature which is intended to link science with philosophy.

### A Suggestion in Patent Reform

THE objections to our patent procedure lies not so much in the organic law as in the methods of enforcement of the contract between the Government and the individual. In the development of our system it has suffered from the same practices that have received public disapproval in ordinary court procedure. Legal technicalities have supplanted in importance the economic aspects of a case, and legal form and procedure have almost attained the dignity of an end instead of a means.

The abuses which have thus found their inception and growth in the practice of adjudicating patent rights have led to the suggestion of a special court of patent appeals with revised rules of procedure and power of final decision. Even this excellent suggestion, however, concerns itself with improvement in the system *after* the patent has been granted, and offers no relief from obvious deficiencies in the system prior to and including the actual grant. The point is that probably much of the trouble now following the grant of a patent might be obviated by greater care in the granting.

Under present conditions a metallurgical or chemical patent in litigation has not received the careful attention of experts until it is called in question. Then it becomes the subject of a long investigation, and expert testimony is brought forward in great volume. The question arises: If experts are deemed necessary to settle a point in litigation, might they not be of equal value in passing scientifically on applications for patent? If, instead of submitting a patent to experts after it has been granted, it were subjected to scientific examination before granting, the prospective patentee might be relieved of much expense, delay and trouble, and would not feel that he had been deceived as to nature and value of the covenant between himself and the Government. Hoover comments on this phase of the matter in his book on Concentration by Flotation, saying that "if courts deprive him (the patentee) of the benefits definitely promised, someone has blundered. Every legal case in which the patents of one litigant are declared invalid is an indictment of the most serious nature against the system."

Another benefit that might result from scientific examination of patent applications would be the rejection of many supposed novel ideas of alleged usefulness. Many of these are scientifically unsound and claim results that are practically impossible of achievement. They merely clutter the record. Others contain alleged improvements and are often introduced by patent pirates and leeches. It is recognized, of course, as Hoover says, that "a new metallurgical process never springs fully developed from the brain of one person," and consequently many of the improvements are valuable. On the other hand, one has only to review the patents and litigation in one subject, such as flotation, to feel that if scientific experts reviewed the applications, many of them might not be granted. The situation would be freer from complications and progress in the industry would not suffer.—*Metallurgical and Chemical Engineering.*

### New Use for Cocoanut Water

THE discovery has just been made at Colombo that cocoanut water, which has always been considered a useless waste product, is an excellent rubber coagulant. Millions of gallons of cocoanut water allowed to run to waste on estates can now be made use of at a good profit.

The cocoanut water is allowed to ferment for four or five days, after which it can be used without further delay as coagulating latex. One to two ounces of the fermented cocoanut water is allowed to coagulate one pint of the pure latex.

This is said to produce a fine rubber, superior to that procured with the use of crude acetic acid. The color of the rubber with acetic acid fermentation is decidedly inferior to the cocoanut water fermentation.

**Cocoanut water is now made up in bulk**

and shipped in large quantities from cocoanut plantations to the various rubber estates.

## The Heavens in May

(*Concluded from page 407.*)

this effect; Venus is nearly twice the diameter of Mars, only 60 per cent of his distance from us, and almost twice as near the Sun, and her surface reflects about three times as much light from each square mile as that of Mars. Jupiter is a morning star in Pisces, rising about 2 A. M. Saturn is still an evening star, and is in conjunction with Mercury on the 31st. Mercury will be 2½ degrees to the north of Saturn and a little the fainter of the two. This will be an excellent opportunity to compare the two planets. Uranus is in quadrature east of the Sun on the 6th, and comes to the meridian at 6 A. M. Neptune is on the borders of Gemini and Cancer, and is observable (telescopically) until 10 P. M.

The Moon is in her last quarter a few minutes after midnight early in the morning of the 6th; she is new at 11 P. M. on the 13th; in her first quarter just before midnight on the evening of the 21st; and is full at 5 P. M. on the 28th.

She is nearest us on the 28th, and farthest away on the 14th. During the month she passes near Uranus on the 6th, Jupiter on the 8th, Venus and Mars on the 11th, Mercury on the 16th, Saturn on the 17th, and Neptune on the 19th. None of the visible conjunctions is close.

### Mellish's Comet (1915a)

Reliable elements of this comet are now available, computed at the University of California from observations extending over more than a month. They show that its perihelion passage will occur on July 17th, at a distance almost exactly equal to that of the Earth from the Sun at the same time.

At this date, however, and for some time previously, it will be so far south in the heavens that we cannot see it at all; indeed, we will lose sight of it in the present month.

Its predicted positions are as follows for 7 P. M. Eastern standard time:

| | | | |
|---|---|---|---|
| April 30th .. | 18h. | 43.9m. | —10° 46′ |
| May 8th ... | 18h. | 51.2m. | —16° 28′ |
| May 16th ... | 19h. | 14.7m. | —25° 23′ |
| May 24th ... | 19h. | 43 m. | —39° 24′ |

On the first of these dates it is 82 million miles from the Earth, and on the last but 42 million, and it is also approaching the Sun, so that it is not surprising that its computed brightness increases nearly six-fold during this short time.

Its track runs through the eastern part of Sagittarius, about 10 degrees east of the "Milk Dipper," and, as the Moon will be out of the way the comet should be easily visible with a field-glass. The best time to look for it will be about 1 A. M.

During the early part of June this comet may be a fine object for southern observers as it will come within about 35 million miles of the Earth. It will be at its brightest about June 10th, when it will pass right over the smaller Magellanic cloud, and be a southern circumpolar object.

As it recedes from the Sun its orbit is roughly parallel with the neighboring part of the Earth's so that the Earth follows it for some time at a gradually increasing distance. It will probably be easily visible to southern observers for many months to come, and will probably become telescopically observable again in northern latitudes before it fades away in the distance.

Princeton University Observatory.

## Variation of Eta Aquilæ

In a note on this short-period variable published in *Astronomische Nachrichten,* M. Fessenkoff endeavors to explain its variation. In 1895 Belopolsky announced that the star has a satellite whose period coincides exactly with that of the star's variation in brightness. The orbit of the satellite has been determined by Wright. As the line of sight from our system does not lie in the plane of this orbit, the star's variation is not due to mutual eclipses, but rather to variations in the amount of surface presented to us, depending upon deformations in the two bodies under the marked tidal effects of their close proximity to each other. They may, in fact, be so close as to partially coalesce at the time of periastron. A secondary cause of variation, affecting the color as well as the brightness of the stars, would be, on this hypothesis, the varying thickness of the atmospheres surrounding the stars, due to variations in the surface area of the bodies, with corresponding variations in the amount of light absorbed.

## In the Trenches*

At first there were grumblers who scorned trenches. The veterans of the Revolution, who had been fighting all over Europe during fifteen years and who delighted in pitched battles, refused to burrow in the earth like moles. They loved to fight, but not to fight underground, and they gave a practical demonstration of this repugnance when they encountered the trenches which Wellington improvised at Torres Vedras for the defence of Lisbon.

The entrenchments at Torres Vedras resembled, on a small scale, those now employed by the Germans. They comprised two lines, one extending from the Zizambro River to the Tagus, a distance of 30 miles, the other somewhat shorter and 7 or 8 miles toward the rear. The construction of these entrenchments required the labor of 25,000 men during one month. They were well built and protected by pitfalls, *chevaux-de-frise* and other obstructions. The trenches which sheltered the soldiers were 16 feet wide and protected by parapets 10 feet in thickness. Each section was provided with casks of drinking water, a toolhouse and a magazine.

The memoirs of Masséna, who commanded the French army, describe various attempts made to draw the enemy out of this formidable position, which Thiébault calls a second Gibraltar. Wellington would not make a sortie. The French had no artillery heavy enough to attack the trenches effectively, and had only enough ammunition for one day of hard fighting. The only thing left was to besiege the enemy to the point of exhaustion, but this did not please the veterans of Jena, who regarded this imprisonment of the enemy as dishonorable and an imitation of their tactics as cowardly. The soldiers grumbled on being set to work digging trenches, and the officers showed their discontent so plainly that Masséna was compelled to order a retreat.

The second experience in underground warfare came at the siege of Sebastopol, in 1855. The investment of this supposedly impregnable stronghold absolutely required these tactics, but the French soldiers liked them no better than their ancestors had liked them 45 years earlier.

A volume of letters written to his family by Paul Goedorp, a lieutenant of Zouaves, during the Crimean war, has just been published. The writer was fresh from Saint Cyr and less than nineteen years old. Naturally brave, he feared neither peril, privation, nor fatigue, but his first turn in the trenches disgusted him. Higher officers were no more enthusiastic. Gen. Bosquet wrote: "This business will hereafter seem impossible; the most seasoned troops will certainly be worn out at the end of the campaign." Marshal Niel recognized that this sapper and miner warfare was depressing to French soldiers. "Fighting in the open air and sunlight," he says, "seems like a pastime in comparison with this working in the bowels of the earth, and its accompanying dangers."

Lieut. Goedorp accustomed himself to the situation, but not without effort, as his letters show, despite their cheerful tone. After his first turn in the trenches he writes that he is "horribly fatigued by a night on guard and two sleepless days." He explains by adding: "We start for the trenches at ten o'clock and return at three on the second day following, making two days and two nights in all. We enter

* An abstract from an article by G. Lenotre in *Le Temps.*

the trench, follow the wall for a long distance, and halt until night, when we are placed in a barely finished section within two hundred yards of a Russian battery."

Later he writes: "All day long I have amused myself in watching the destruction of the Russian guns by our shells. I shuddered a little on seeing dismembered corpses tossed into the air, but this will not effect me when I return to the trenches." This inhumation at intervals of three days is "nothing but dangerous drudgery." It was most tantalizing to see from the muddy trenches the Malakoff tower, which it would be so "amusing" to take by assault, but it was necessary to hide and dig in the earth until the artillery should have completed its task. What humiliation for a Zouave! Occasionally there is a note of ill humor: "At present we are doing absolutely nothing, except to go to the trenches, mount guard and dig. This sort of work is killing us. In one month the regiment has lost 700 men through death, wounds and fatigue. It is hard to have an average of 50 men *hors de combat* for each trench. A fine regiment like ours is being destroyed in a very foolish manner. To be killed in a trench, what a glorious fate!"

It was maddening to see, so near, the forts which the Zouaves would annihilate so easily if they were only "let go." "I thought I was coming to a grand festival, but I have been doing siege duty for four months. The impetuous young lieutenant condemns as incompetent, almost as criminal, the artillery and engineer officers responsible for the delay."

It was fated that he should not take part in the "grand festival." A week before the assault that he had longed for was made, he was struck by a shell splinter and died without having had the good fortune to fight "with bared heart, face to face with the enemy," as he had so often dreamed of doing.

## War Capacity of United States Railways

By Dr. Robert Grimshaw

TWO salient features enter into railway capacity for war: first, rolling stock; second, track and yard limitations in a given theater of operations. The latter, being dependent upon the local conditions of any given theater of operations, will not be discussed here.

Concerning rolling stock, the equipment of our railways is ample for the assembling of units at their rendezvous or home stations, and for assembling divisions at their places of concentration; this without overtaxing the resources of our various commercial lines.

Concerning the concentration of divisions into field armies for operations in any possible theater of operations on our coasts or borders, by simultaneous large scale movements, the problem becomes more complicated, but, on the basis of our present war plan strength, still remains within the "capacity" of our commercial lines.

Tables I, II, and III, herewith, present data for reference in connection with the capacity of our railways for movements of troops.

Paragraph 393, Field Service Regulations, United States Army, 1914, gives the details of entraining; and reference thereto will show that the weights of equipments carried by infantry soldiers, etc., are not factors used in arranging railway movements of troops. Arms and equipments carried by individuals are customarily taken with them upon the cars; while wagons, animals, ammunition, rations and other impedimenta, usually carried by wagons when on the march, are loaded prior to the entraining of the men. The following factors are used in determining car and train section capacities:

(1) A train section usually consists, exclusive of engine and tender, of not more than 17 cars, total weight not over 700 tons; the weight of loaded cars being taken as: flat 25, box 27, stock 25, passenger and baggage 50, Pullman 55.

(2) Car capacities: tourist sleepers, 42 men.

Coaches, 45 men (3 men to each two seats); stock cars, 20 to 22 animals,

Box freight cars, 20 to 30 tons, dependent on bulk.

Flat cars:

(*a*) One gun, two caissons, field artillery.

(*b*) Three caissons, field artillery.

(*c*) Two caissons and one battery or store wagon, field artillery.

(*d*) One gun, one caisson, heavy artillery.

(*e*) Two guns, heavy artillery.

(*f*) Three caissons, heavy artillery.

(*g*) Three wagons, field ammunition or supply; or three ambulances—set up.

(*h*) One ponton on its wagon.

(*i*) Forty-eight wagon bodies, knocked down; or thirty-six if tunnels are met.

(*k*) Six ambulances, knocked down, tops not removed.

(*l*) Thirty tons freight.

The following table shows the cars required per unit of organization:

TABLE I.

| | Personnel, etc. | | | | Cars Required. | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Men | Animals | Vehicles | Guns (vehicles) | Pullman or Tourist | Coaches | Baggage (kitchen) | Box | Stock | Flat | Total Cars |
| Infantry Regiment | 1,915 | 171 | 22 | .. | 5 | 43 | 6 | 5 | 11 | 8 | 78 |
| Cavalry Regiment | 1,308 | 1,435 | 26 | .. | 8 | 29 | 9 | 8 | 67 | 9 | 130 |
| Artillery Regiment (field) | 1,198 | 1,154 | 104 | 24 | 9 | 23 | 9 | 9 | 56 | 45 | 151 |
| Artillery Regiment (horse) | 1,198 | 1,568 | 107 | 24 | 10 | 24 | 10 | 9 | 78 | 46 | 177 |
| Artillery Regiment (heavy) | 1,286 | 1,346 | 107 | 24 | 10 | 27 | 10 | 9 | 68 | 54 | 178 |
| Artillery Reg'mt (mountain) | 1,165 | 1,186 | ... | .. | 7 | 23 | 8 | 14 | 60 | .. | 112 |
| Batallion Engineers (Inf.) | 514 | 165 | 12 | .. | 2 | 12 | 2 | 4 | 8 | 4 | 32 |
| Batallion Engineers (Cav.) | 288 | 370 | 11 | .. | 2 | 7 | 2 | 4 | 19 | 4 | 38 |
| Batallion Signal Corps (Inf.) | 176 | 202 | 15 | .. | 2 | 4 | 2 | 2 | 10 | 5 | 25 |
| Batallion Signal Corps (Cav.) | 176 | 204 | 11 | .. | 2 | 4 | 2 | 2 | 10 | 4 | 24 |
| Divisional Trains (Inf.) | 1,008 | 1,936 | 387 | .. | 11 | 16 | 11 | 36 | 97 | 18 | 189 |
| Divisional Trains (Cav.) | 609 | 1,313 | 161 | .. | 7 | 10 | 7 | 17 | 65 | 10 | 116 |

The above table shows the cars normally required by the different units of a large force, such as a field army, excepting ponton battalions, aero squadrons, and the headquarters of brigades and divisions.

In compiling the table, the divisional trains of both the cavalry and infantry divisions were assumed "knocked down," all other vehicles being shipped "set up"; and a reasonable regard was given to keeping units together in convenient train sections, without separating the troops of any unit from their animals and material.

Can our roads handle such masses of men and material? We can judge this from Table II, which shows the rolling stock of the principal railway systems of the United States east of the Mississippi River (Poor's Railway Manual, 1914), and from Table III, a memorandum of the cars required for an American field army, composed of units in normal proportions.

All the foregoing data are official, and were furnished by an officer of the regular Army.

TABLE II.

| | Locomotives. | Cars. | | | | | |
|---|---|---|---|---|---|---|---|
| | | Passenger. | Baggage | Box | Stock | Flat | Total |
| Penn'a R. R. System | 7,033 | 4,277 | 706 | 84,576 | 4,229 | 5,419 | 99,207 |
| N. Y. C. R. R. System | 4,413 | 3,723 | | 67,863 | 2,106 | 10,871 | 84,563 |
| So. Ry. & N. & W. | 1,501 | 338 | 223 | 18,049 | 2,328 | 2,878 | 24,058 |
| | | 232 | | | | | |
| Seaboard & Atlantic Coast Lines. | 1,162 | 497 | 249 | 31,374 | 158 | 8,252 | 40,530 |
| B. & O. and C. & O | 2,579 | 834 | 317 | 40,127 | 400 | 2,943 | 44,621 |
| I. C., C. N. O. & T. P | 1,700 | 581 | 193 | 32,090 | 1,047 | 3,369 | 37,280 |
| Totals | 18,388 | 6,527 | 1,698 | 274,079 | 10,268 | 33,732 | 330,259 |
| | | 3.955 | | | | | |

TABLE III.

| | Passenger | Baggage | Box | Stock | Flat | Total |
|---|---|---|---|---|---|---|
| 27 Regiments Infantry | 1,296 | 162 | 135 | 297 | 216 | 2,106 |
| 9 Regiments Cavalry | 333 | 81 | 72 | 603 | 81 | 1,170 |
| 6 Regiments Field Artillery | 192 | 54 | 54 | 336 | 270 | 906 |
| 1 Regiment Heavy Artillery | 37 | 10 | 9 | 68 | 54 | 178 |
| 1 Regiment Horse Artillery | 34 | 10 | 9 | 78 | 46 | 177 |
| 1 Regiment Mountain Artillery | 30 | 8 | 14 | 60 | ........ | 112 |
| 4 Battalions Engineers (Inf. Div., etc.) | 56 | 8 | 16 | 32 | 16 | 128 |
| 1 Battalion Engineers (Cavalry) | 9 | 2 | 4 | 19 | 4 | 38 |
| 4 Battalions Signal Troops (Inf. etc.) | 24 | 8 | 8 | 40 | 20 | 100 |
| 1 Battalion Signal Troops (Cavalry) | 6 | 2 | 2 | 10 | 4 | 24 |
| 3 Divisional Trains (Infantry) | 81 | 33 | 108 | 291 | 54 | 567 |
| 1 Divisional Train (Cavalry) | 17 | 7 | 17 | 65 | 10 | 116 |
| Totals, 363 Locomotives and | 2,115 | 385 | 448 | 1,899 | 775 | 5,622 |

## Statistics of Baseball

**By Arthur Macdonald**

IF everything which takes place in the game were recorded, we might have proper statistics of baseball. A few data in addition to the official records have been gathered.

It is estimated that approximately 20 per cent of balls batted fair result in safe hits.

Of 10,074 batted balls, 3,602 or 20 per cent were fly balls; 5,171 or 51 per cent were grounders; 344 or 3 per cent bunts; and 957 or 9 per cent were line drives. Out of these 10,074 batted balls, 2,067 or 20 per cent were scored as base hits. Of the 3,602 fly balls, 741 or 20 per cent fell safe, and only 18 or 4/10ths per cent were muffed, showing practically that the major league fielders catch almost every ball they can reach.

Of the 5,171 ground balls, 424 or 8 per cent were scored hits. Of the 344 bunts, 155 or 45 per cent were safe, and of these 155, 114 or 74 per cent were handled by the fielders. Out of the 957 line drives, 741 or 77 per cent were safe, showing this to be the best kind of ball to knock.

In a number of games (not given), 72 plain hit and run signals were detected; 11 of these attempts, or 15 per cent, resulted in clean hits, 8 of which, or 11 per cent, enabled the runners to take extra bases; 27 of the attempts, or 40 per cent, advanced runners at the expense of retiring the batter at first base; 7 or 9 per cent resulted in batter striking out, and 3 of these strike-outs or 4 per cent resulted in the runner being doubled with the batter, while 2 of the strike-outs or 3 per

cent resulted in the runner reaching second.

Seventeen runners, or 23 per cent, were forced to second with no gain; 3 (4 per cent) were doubled on line drives, and 7 (9 per cent) of the batters flied out. The hit and run play succeeded in its object 50 out of 70 times, or 69 per cent.

Sacrifice hits average about one-third more than stolen bases, and the hit and run play occurs 60 per cent oftener than stealing bases. Table 1 gives some averages of the major leagues for five seasons:

TABLE 1.

*Averages of Major Leagues (five seasons).*

89,156 batters:
- 27,058 (30 per cent) reach first base.
- 17,138 (19 per cent) reach second base.
- 19,154 (21 per cent) reach first base on safe hits.
- 12,882 (14 per cent) reach third base.
- 8,272 (9 per cent) score.
- 1,303 (1 per cent) reach first base on errors.
- 5,956 (6 per cent) reach bases on balls.

2,744 (3 per cent) stolen bases:
- 1,951 (71 per cent) are stolen at second base.
- 774 (28 per cent) are stolen at third base.
- 19 (1 per cent) are stolen at home.

The best test of a player is, of course, his playing. But when players are somewhat equal and managers desire to select new men, the following anthropological data might be of service:

Name, age, color of hair and eyes, date and place of birth.
Height, sitting height, arm reach, and weight.
Length of arm and forearm, length, width and strength of hand and finger.
Circumference and depth of chest, and lung capacity.
Pulse, respiration, temperature.
Keenness of vision and accuracy of aim.
Nationality of father and mother, former occupation, education.

Most of the measurements here suggested are important ones in anthropology. Length of arm and forearm and length and width of hand and fingers might yield knowledge as to throwing and pitching. Thus, long, strong fingers are considered advantageous for pitchers. Also keenness of vision and accuracy of aim are worthy of consideration, especially for batting. Other data might be added, but those mentioned are sufficient to indicate plan of scientific study of the player himself.

It is often said that it is the little things which win the game. It may be true, therefore, that the anthropological knowledge here sought would furnish points instructive not only to the manager in choosing and comprehending his players, but in helping the player to understand himself better.

For instance, if the length of arm and forearm, length, width, and strength of hands and fingers of players were recorded, some practical knowledge as to pitching and throwing qualifications might be gained. Thus it is said that Mathewson's strength of hand or fingers is an important factor in his success with curves.

The question of a long body (sitting height) might prove of value, for such individuals are frequently strong, heavy, and fast runners; and especially as to running and general staying qualities, the chest measurements, lung capacity, pulse, and respiration should be studied carefully.

TABLE 2.

*Stature in Relation to Batting and Fielding.*

Data concerning 140 leading baseball players, designated by the *Baseball Magazine:*

| | No. | Per Cent. |
|---|---|---|
| Players 5 feet 11 inches or more in height | 69 | 100 |
| Batting average 250 or more | 30 | 43 |
| Batting average less than 250 | 39 | 57 |
| Fielding average 950 or more | 40 | 58 |
| Fielding average less than 950 | 29 | 42 |
| Those who bat and throw left-handed | 3 | 4 |
| | No. | Per Cent. |
| Players less than 5 feet 11 inches in height | 71 | 100 |
| Batting average 250 or more | 44 | 62 |
| Batting average less than 250 | 27 | 38 |
| Fielding average 950 or more | 47 | 66 |
| Fielding average less than 950 | 24 | 34 |
| Those who bat and throw left-handed | 6 | 8 |

From an examination of this table (2) it will be seen that of the 140 leading major league players (designated as such by the *Baseball Magazine*), those who are less than 5 feet 11 inches in height are in general both better batters and fielders than those who are taller, and this superiority is greater in the batting than the

fielding. Nine (6 per cent) of these 140 players bat and throw left-handed, and six of them are of shorter stature.

*Right and Left-handed Players.*—In Table 3 are given a few figures comparing right and left-handed players. The figures are not, however, large enough to base conclusions upon, still they are suggestive and indicate the value of gathering data of anthropological nature of all professional baseball players. For with sufficiently large numbers important knowledge could be obtained.

From Table 3 it will be seen that 10 per cent of all the players throw left-handed, and 17 per cent bat left-handed and throw right-handed, and that 77 per cent of the latter are less than 5 feet 11 inches in height, or belong to those of shorter stature.

*Pitchers Compared.*—Table 4 gives some comparisons as to pitchers. Their number is relatively large (26 per cent). As will be noted, the pitchers are relatively tall men, 74 per cent of them being 5 feet 11 inches or more in height. Their batting average is very low, only 7 per cent having 250 or more.

TABLE 3.
*Right and Left-handed Players.*

| | No. | Per Cent. |
|---|---|---|
| Total number of leading players | 150 | 100 |
| Those who throw left-handed | 15 | 10 |
| Those who throw right-handed | 135 | 90 |
| Those who bat left and throw right | 27 | 17 |
| Players who throw left-handed | 15 | 100 |
| Those 5 feet 11 inches or more in height | 7 | 50 |
| Those less than 5 feet 11 inches in height | 7 | 50 |
| Those with batting average 250 or more | 6 | 40 |
| Those with batting average less than 250 | 9 | 60 |
| Those with fielding average 950 or more | 8 | 53 |
| Those with fielding average less than 950 | 7 | 47 |
| | No. | Per Cent. |
| Players who throw right but bat left-handed | 27 | 100 |
| Those 5 feet 11 inches or more in height | 6 | 23 |
| Those less than 5 feet 11 inches in height | 20 | 77 |
| Those with batting average 250 or more | 13 | 50 |
| Those with batting average less than 250 | 13 | 50 |
| Those with fielding average 950 or more | 13 | 50 |

TABLE 4.
*Pitchers.*

| | No. | Per Cent. |
|---|---|---|
| Total number of leading players | 150 | 100 |
| Number of pitchers | 49 | 26 |
| Remaining number of the players | 101 | 74 |
| Number of pitchers | 49 | 100 |
| Those 5 feet 11 inches or more in height | 34 | 74 |
| Those less than 5 feet 11 inches in height | 12 | 26 |
| Those with batting average 250 or more | 7 | 14 |
| Those with batting average less than 250 | 42 | 86 |
| Those with fielding average 950 or more | 24 | 49 |
| Those with fielding average less than 950 | 25 | 51 |
| Number of pitchers | 49 | 100 |
| Those who bat and pitch right-handed | 35 | 76 |
| Those who bat and pitch left-handed | 9 | 20 |
| Those who bat left and throw right-handed | 1 | 2 |
| Those who bat right and throw left-handed | 1 | 2 |

TABLE 5.
*Average Height and Weight of Players.*

Leading baseball players, designated by the *Baseball Magazine:*

| | No. | Average Height. Ft. | In. | Average Weight. Lbs. |
|---|---|---|---|---|
| All players | 150 | 5 | 9 1/2 | 174 |
| Right-handed | 135 | 5 | 9 3/8 | 174 |
| Left-handed | 15 | 5 | 10 3/5 | 175 |
| Pitchers | 49 | 5 | 11 4/5 | 175 |
| Right-handed | 35 | 5 | 11 4/5 | 174 |
| Left-handed | | 5 | 10 4/5 | 177 |
| Players who bat left and throw right | 27 | 5 | 9 7/10 | 170 |
| Basemen | 32 | 5 | 10 2/5 | 174 |
| Outfielders | 35 | 5 | 9 4/5 | 171 |
| Catchers | 18 | 5 | 10 2/5 | 178 |
| Leading batters | 13 | 5 | 10 3/5 | 175 |
| Shortstops | 11 | 5 | 9 2/5 | 167 |

Table 5 presents data as to average height and weight of 150 leading baseball players.

As already indicated, the figures are not large enough to serve more than in the way of suggestion. The catchers are the heaviest

(178 pounds) and the shortstops the lightest (167 pounds) in weight. Those left-handed are the heaviest both among the players in general (175 pounds), and in the case of the left-handed pitcher (177 pounds) as compared with those pitching right-handed (174 pounds).

Some apparent discrepancies are due to the fact that it was impossible to obtain figures in all cases.

As might be expected, the outfielders are lighter in weight (171 pounds) than the basemen (174 pounds).

Those who bat left and throw right-handed seem to be lighter in weight (170 pounds) than the average (174 pounds).

It is evident that the leading players of the highest class would have excellent physical and symmetrical development, as indicated by the figures for heights and weights in the table. Differences, therefore, between their measurements have more significance than if compared with ball players in general.

*Proposed Statistics of Flies and Grounders.*—In consulting with official scorers, I find that no systematic account is taken of flies and grounders, and so it is not possible to determine whether or not the clubs knocking the fewest flies and the largest number of grounders relative to the number of games are in general winners. Such data and many others not yet recorded, when carefully studied, might show a principle or general trend of law, which might change some of the rules, plays, and methods now in vogue.

Table 6 gives a *tentative* classification of flies and grounders which might be recorded:

TABLE 6.

*Flies and Grounders.*

High fly to right, center, or left infield, or outfield, or foul.
Long fly to right, center, or left infield, or outfield, or foul.
Line fly to right, center, or left infield, or outfield, or foul.
Sacrifice fly to right, center, or left infield, or outfield, or foul.
Pop fly to right, center, or left infield, or outfield, or foul.
Home run grounder to right, center, or left infield, or outfield.
Home run fly to right, center, or left infield, or outfield.
Home run line to right, center, or left infield, or outfield.
One, two, or three-base hits to right, center, or left infield, or outfield.
Swift grounders to right, center, or left infield, or outfield, or foul.
Slow grounders to right, center, or left infield, or outfield, or foul.
Grass cutters to right, center, or left infield, or outfield, or foul.
Chop balls to right, center, or left infield, or outfield, or foul.
Bunts to right, center, or left infield, or outfield, or foul.

If at the end of the season a player should find that he has been knocking more high flies, or undesirable kind of hits than he had any idea of, or that a large per cent of his bunts had failed of their purpose, such unexpected knowledge might help him to find the cause and apply the remedy.

In short, if we desire to determine more definitely the general laws of the game, most successful kind of plays and tricks and to what extent they should be followed, and to settle disputed questions, as already emphasized, everything that takes place in the game from beginning to end should be recorded.

It may seem to some that so many details would be useless, but in all scientific inquiry it is presumptuous to assume to know in advance what facts are important and what ones are not; only the omniscient can do that.

But it may be said that there is danger of making the game too exact to be interesting. There is, however, no probability of this, since at best, owing to the complexity and necessary chances of the game, there will always be a sufficient number of unexpected events to relieve the supposed scientific monotony.

TIME AND PLACE OF BIRTH OF MAJOR LEAGUE PLAYERS.

TABLE 7.

*Time and Place of Birth.*

| Leading baseball players in the United States: | No. | Per Cent. |
|---|---|---|
| Total number selected.......... | 146 | 100 |
| Those born in country.......... | 90 | 61 |
| Those born in city.............. | 56 | 39 |
| Those born in warmer months.. | 95 | 69 |
| Those born in colder months.... | 51 | 31 |

In Table 7 are given the number and per cent of those major league players who were born in (1) the country and those born in the (2) city; also those born in the (3) warmer months, and those in (4) the colder months. By city is meant all towns of 30,000 or more inhabitants. All places less than 30,000 are counted as country. November, December, January, February, March, and April are the colder months, and May, June, July, August, September, and October the warmer months. It will be seen that 22 per cent more are born in the country and 38 per cent more in the warmer months. It has been established in Switzerland, that children born in summer are taller and heavier than children born in winter. It is generally believed that those living in the country are stronger and healthier than those living in cities. These facts as given in Table 7 for the players confirm the results of investigations as to the advantage of country life and being born in the warmer months. In the summer the mother and child are outdoors more, and food is cheaper and better. But, it may be asked, are not more children in the general population born in warm seasons than in cold seasons? The few statistics in this matter show there is no great difference, as indicated in Table 8, giving the number of births per 1,000 population for the colder and warmer months in Great Britain:

TABLE 8.
*Birth Rate in Great Britain.*

| | 1908 | 1909 | 1910 |
|---|---|---|---|
| Birth rate in January, February, and March | 25.9 | 25.9 | 24.8 |
| Birth rate in April, May, and June | 27.6 | 26.6 | 26.1 |
| Birth rate in July, August, and September | 26.3 | 25.1 | 24.7 |
| Birth rate in October, November, and December | 24.4 | 24.2 | 23.3 |

*Anthropology Fundamental.*—The importance of anthropological data in the investigation of all classes of men is fundamental, whether it be a study of normal or abnormal man, genius, insane, or criminal; talented man, congressional man, or baseball man, or any class of men; it is all *man*, and the method is practically the same. There must be a general criterion or measuring rod for estimating and understanding physical and mental superiority and distinguishing them from the average and the mediocre.

All, therefore, which will make baseball more scientific as well as more interesting will not only increase the financial receipts, but, what is better, still further encourage boys and young men to play the game more and more, and thereby find a pleasant way of developing sound bodies and sound minds, which will make them better citizens.—*Abstracted from American Physical Education Review.*

## German War Diet for Horses

THE German government has restricted the quantity of oats which may be given to a horse to 2½ to 3½ pounds daily, and German horse owners are afraid that this restriction will injuriously affect the health and usefulness of their animals. In a recent issue of the Berlin *Lokal Anzeiger*, Dr. Klingner, city veterinary, shows that these fears are groundless. His experiments, carried on during many years with large numbers of horses, convinced him that maize forms a very satisfactory substitute for oats. At present, however, maize is as scarce as oats, so that some other substitute must be found. The most obvious one is potatoes, which are very abundant and have been stored in great quantities by all German communities.

Potatoes differ from maize, chiefly in containing a little less starch and considerably less digestible albumen. The deficiency in starch can be met by increasing the ration, and the deficiency in albumen can be compensated by adding a small quantity of some food that is rich in albumen.

The change in diet must not be made too sudden, and the idiosyncrasies of individual horses must be considered. Most horses bear the change very well, but a few animals suffer from catarrh of the stomach or bowels. In such cases the

attending veterinary must prescribe the quantity of the new fodder to be given. The guiding principle in each stable should be to maintain the former rations of starch and albumen, despite the change in fodder.

Dr. Klingner has proved by experiment that the entire grain ration of horses can safely be replaced by potato flakes or steamed fresh potatoes, if a sufficient quantity of good hay or chopped straw is given also. Other farm animals bear the deprivation of grain even better than horses do, and Dr. Klingner expects permanent advantages to flow from successful experience with the war diet which is now enforced temporarily.

### The Discovery of Radium in Coal

A SERIES of remarkably interesting experiments have been recently carried out in the west of England by certain scientists to demonstrate the extraordinary effect on vegetable growth produced by the addition to the soil of radium-bearing and radio-active materials.

A full and instructive account of some of these experiments was given, some little time ago, in a lecture before the Royal Society of Arts by Mr. T. Thorne Baker.

It appears that radishes and other root crops are obtained nearly *five* times as large as those grown in untreated soil at the same time.

If this process could be generally adopted by our agriculturists in this country, the increase in the prosperity of the nation would be very large.

The initial cost of such a system has hitherto stood in the way of its general adoption.

But the recent discovery by M. M. Détaille and Lafayaise, the two distinguished French chemists of Paris, and Prof. Scammell, M.S.C.I., of Hadleigh, Essex, that coal contains radium, which, in the form of "lignaite," can be used for the radiumization of the soil, places the process within the reach of every agriculturist in the country.

Fruits, flowers, and vegetables can be grown in a much *shorter* time, in much larger quantities, and of finer quality by the use of "lignaite," the cost of the treatment of an ordinary sized garden being very trifling; the process is available for use by the humblest worshiper at the shrine of Flora.

Once more in the history of human progress the world is indebted to the brilliancy and originality of French scientific thought and research, and with a view to enable the country at large to benefit by their discoveries, the eminent chemists mentioned are sending to all applicants full details of the best methods of applying the "lignaite" to the soil.

The importance of this discovery to the small land owner or cultivator is obvious; it is now possible for the man with two or three acres of ground to make a substantial profit each year, sufficient to keep his family and himself in comfort.

And this discovery, viz., medicatrix naturæ, the latest and most beneficent of the achievements of science, goes far to solve the land problem and pave the way for the reappearance of the sturdy peasant proprietor, the backbone of the country.

### An Organization for "Nova" Search

MR. W. H. STEAVENSON of the British Astronomical Association is organizing a section of that association which will devote itself to the task of keeping a lookout for new stars. Each member will be given a portion of the Milky Way, the size of which will depend largely upon the number of observers. He will make himself acquainted with every star in the area down to about magnitude 6.5, or lower if he has the time and inclination. As soon as he is familiar with this area, his work will consist simply in making a rapid survey of it at least once every fine night, if possible. It is hoped that members will also familiarize themselves with the stars in other parts of the Milky Way down to about magnitude 4.5, in order to increase the chances of the prompt discovery of novæ in areas whose

regular observers are prevented from making their nightly survey, by cloudy weather or otherwise.

### The Danger of Delay in Cancer

THOUSANDS of lives now needlessly sacrificed to cancer could be saved if the patient would go to the surgeon as promptly as does the average person attacked by appendicitis. Nor is there any reason why the cancer patient should not seek this, the only safe treatment, with the same high degree of confidence in the outcome that is now common among those suffering from the other more fashionable disease. Unfortunately, the evidence is only too clear that a different attitude toward cancer prevails and occasions many preventable deaths. The almost superstitious dread of the disease and unwillingness to admit its existence or to seek medical advice in time are well known and difficult obstacles to progress in its control. Proof of this fatal neglect is found in the experience of a prominent surgeon who recently studied his case records in order to obtain definite information as to the delay in the average case. Of sixty-five recent patients, thirty-five were men and thirty were women. Further study of these sixty-five cases showed that after the first discovery of suspicious symptoms the men had waited an average of 12.2 months before consulting the doctor, and the women had waited, on the average, 11.9 months, practically a year's delay in all cases. Many other surgeons could produce very similar records. Winter, of Koenigsberg, Prussia, the pioneer in the education of the public in regard to cancer, examined the records of 1,062 operable cases and showed that 87 per cent of these patients could and should have applied for treatment much earlier, when they would have had a far higher chance of recovery than was actually the case.

To the delay when the symptoms are manifest must be added the previous indefinite period after the beginning of the disease and before the patient realizes the trouble. This period can be shortened by education. Fortunately, the symptoms of cancer are present rather early and can usually be recognized if the patient understands their importance. In too many instances, however, the disease is not suspected until the symptoms are pronounced or until there is a tumor of considerable size. If we assume that this period averages six months, and then add the year's delay for which the patient is responsible, we find that the average patient does not seek advice until at least a year and a half after the onset of cancer. This precious time, thrown away, means, if not a fatal outcome, at least a serious instead of a minor operation.

In the present state of our knowledge of malignant disease it cannot be too frequently emphasized that the hope of curing cancer is to be found in its earlier recognition and in prompt and competent surgical treatment. The unfortunate patient who, because of ignorance or unwarranted fear or the blandishments of quacks, hesitates to seek proper advice should realize that in this delay he or she is recklessly throwing away a splendid chance of cure.

### "The Moon is a Dead Planet"

IS this common statement true? A long discussion was precipitated at a recent meeting of the British Astronomical Association by an article published by Prof. W. H. Pickering in the November, 1914, number of *Popular Astronomy*, in which the writer appeals to astronomers—and especially amateurs, because "scarcely any professional astronomers look at the moon nowadays" to report their observations of apparent changes on the moon, so that "we shall at length nail that ancient falsehood that 'the moon is a dead planet.'" Prof. Pickering began asserting the existence of vegetation on the moon more than twenty years ago, and has been writing on this subject at frequent intervals ever since. The same idea had been favored by certain earlier astronomers, notably by Sir William Herschel. Yet the unqualified statement as to the complete lifelessness of our satellite is repeated in almost every new book on astronomy. The subject is still a moot one, and the discussion above mentioned indicates that few members of the British Astronomical Association share Prof. Pickering's views. The latter astronomer publishes in the March, 1915, number of *Popular Astronomy* an article on "The Meteorology of the Moon," in which he details numerous observations of apparent patches of snow, ice, mist, etc., on the moon.

### A New Explanation of Brontides

THE SCIENTIFIC AMERICAN SUPPLEMENT of January 18th, 1913, contained an account of the mysterious explosive sounds common in various parts of the world, and known under scores of names, the most familiar being *brontidi* (or *brontides*), *mistpoeffers*, and *Barisal* guns. The latest attempt to explain these phenomena (or some instances of them) is due to Wilhelm Krebs, who records the fact that the cannonading in the North Sea fight of January 24th and in the airship attack on the English coast, January 19th, was heard on the coast of Holland, the distance being of the order of 100 to 120 miles. Krebs invokes the Wegener hypothesis of a reflection of sound (i. e., an echo) from a surface of discontinuity supposed to exist in the upper atmosphere, some fifty miles above the earth. Although Wegener's hypothesis appears to be altogether fallacious, the mere fact that such remote cannonading was heard along a coast where mistpoeffers are often reported suggests that these sounds may frequently be due to ordinary explosions, such as blasting operations, target practice of warships, and the like, under atmospheric conditions insuring audibility at a greater distance than usual. It appears that the fisher-folk on the Flemish coast are in the habit of saying, when mistpoeffers are heard, "They're shooting in England," which may be an accurate statement.

**Some Adjudicated Patents.**—The Mygatt design patent No. 37,967 for a prismatic glass reflector has been held valid and infringed in Mygatt v. Schaffer 218 Fed. Rep. 827 while in the suit between the same parties the Mygatt patent No. 40,182 for a design for prismatic glass reflector has been held void for anticipation by design patent No. 40,140 to the same inventor. The Watson patent No. 559,642 for corrugated metal culvert has been held valid and infringed in Stillwell v. McPherson 218 Fed. Rep. 839; the Smith patent No. 692,935 for a weft replenishing mechanism for looms was held void for anticipation in Crompton & Knowles Loom Works v. Stafford Company 218 Fed. Rep. 841; the Mygatt patent No. 939,062 for an integral shade-reflector of glass held void and infringed in Mygatt v. Schaffer 218 Fed. Rep. 827; in Karl Keifer Machine Company v. Unionwerke A. G. 218 Fed. Rep. 847 the Keifer reissue patent No. 12,455 (original No. 797,122) for a filter pulp packing machine for pressing filter cake for beer filters was held valid but not infringed; the Keifer patent No. 993,780 for a filter claim 1 was held valid but not infringed; the Keifer patent No. 1,015,326 claims 14 to 17 inclusive for a filter were held void for insufficient description and want of statutory affidavit and claims 23 to 25 inclusive for a filter cake held void for lack of novelty and the Keifer patent No. 1,023,254 for a filter for straining beer was held void for lack of novelty in view of the prior art.

**"Manufacture" and Range of Equivalents.**—In Thacher v. City of Baltimore 219 Fed. Rep. 909 the court held that an arch of a bridge or like structure is a "manufacture" within the meaning of the patent law; also that, however limited the range of equivalents to which a patent is entitled, equivalency must be commensurate with the extent of the invention; also held the Thacher patent No. 617,615 for a reinforced concrete arch valid and infringed.

# Packard New Model Trucks stand the

# LEDGER TEST

They have been subjected to every possible test of shop and of road.

Their advanced design is based on seven years' experience gained from the daily work of Packard trucks of the previous series.

The mechanical reasons for their efficiency and their economy of operation and maintenance are plain even to the unpracticed eye.

You can lay your finger right on the features that insure a balance on the right side of the ledger when all the operation costs and all the operation profits have been posted.

This new series of silent, up-to-date chainless trucks comprises 1, 1½, 2, 3, 4, 5 and 6-ton sizes, each possessed of the same advanced features. Early delivery on the 3 and 4-ton sizes.

To see them, or the catalog of them, is well worth the while of every business man.

Packardize your hauling and thereby make it stand the ledger test.

Packard Motor Car Company·Detroit

MADE IN DETROIT USA

Packard


MURAD
Every-where
Why?
MURAD
TURKISH
CIGARETTES
ANARGYROS.
FIFTEEN
CENTS
The
Turkish Cigarette
Anargyros
A CORPORATION
Makers of the Highest
Grade Turkish and
Egyptian Cigarettes
in the World

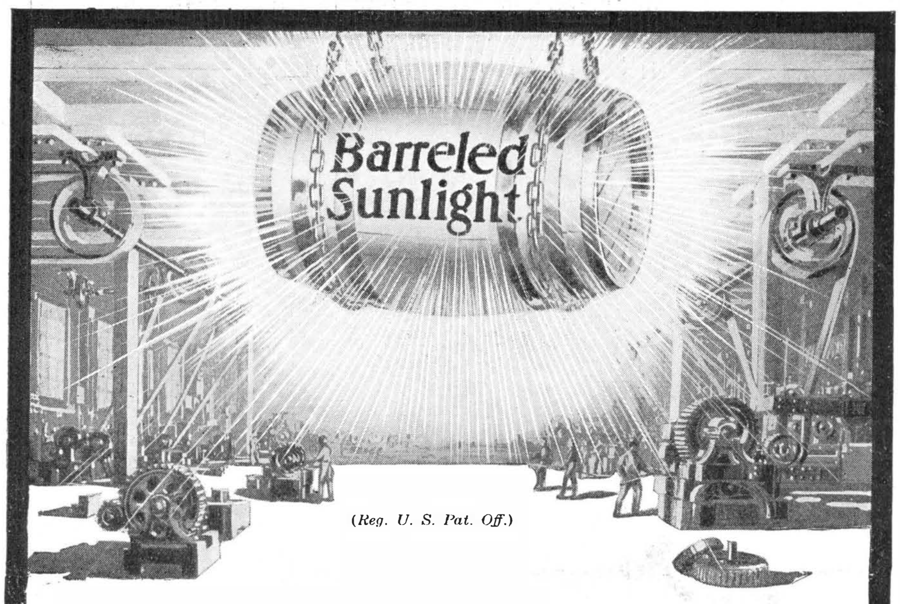
# SCIENTIFIC AMERICAN

THE NEW LAURENTI SUBMARINE SALVAGE BOAT AND TESTING DOCK.—[See page 430.]

Vol. CXII. No. 19
May 8, 1915

Munn & Co., Inc., Publishers
New York, N. Y.

Price 10 Cents
$3.00 A Year




# Maximum daylight in your plant means maximum profits

Efficiency experts have proved that men turn out more and better work in a given time, if they can see perfectly. Rice's Mill-White on ceilings and walls gives a glossy tile-like permanent finish, which increases daylight 19% to 36%.

Over 3,000 firms will verify this; also that Rice's improves sanitary conditions, because it is washable. It also saves money for it does not need repainting for years. It does not crack nor scale under ceiling vibration. **Rice's can be applied directly over old cold water paint by the "Rice Method."**

# RICE'S
## GLOSS
# MILL-WHITE

is the original "mill-white." All others are imitations. It is the only one which contains no varnish. Varnish paints dry too brittle and are liable to crack and peel. Rice's is an OIL paint. Its surface therefore is elastic, though firm, and withstands ceiling vibrations.

Rice's is made by a process over which we have exclusive control, which causes it to remain white longer than any other and prevents it from either cracking or peeling. The tremendous advantages of this process enable us to make the following guarantee:

**WE GUARANTEE** that if Rice's does not remain white longer than any other gloss paint, applied at the same time and under the same conditions, *we will give free, enough Rice's to repaint the job with one coat.* We also guarantee that, properly applied, Rice's will not flake or scale. You cannot lose under this guarantee.

**Sold direct from factory**

Rice's is sold direct from the factory, in barrels containing sufficient paint to cover 20,000 square feet—one coat.

***Write for booklet, "More Light," and Sample Board.***

**U. S. Gutta Percha Paint Co.**
**23 Dudley Street Providence R. I.**

**On concrete surfaces**

On inside concrete Rice's Granolith makes the best possible primer for a second coat of Rice's Gloss Mill-White—giving a tile-like enamel finish at no more expense than lead and oil paint.

**Rice's Granolith**

# "This is the original *effective* non-skid tire"

***—says Old Man Mileage***


"The Republic Staggard Tread was originated at a time when there wasn't a single *effective* non-skid tread on the market.

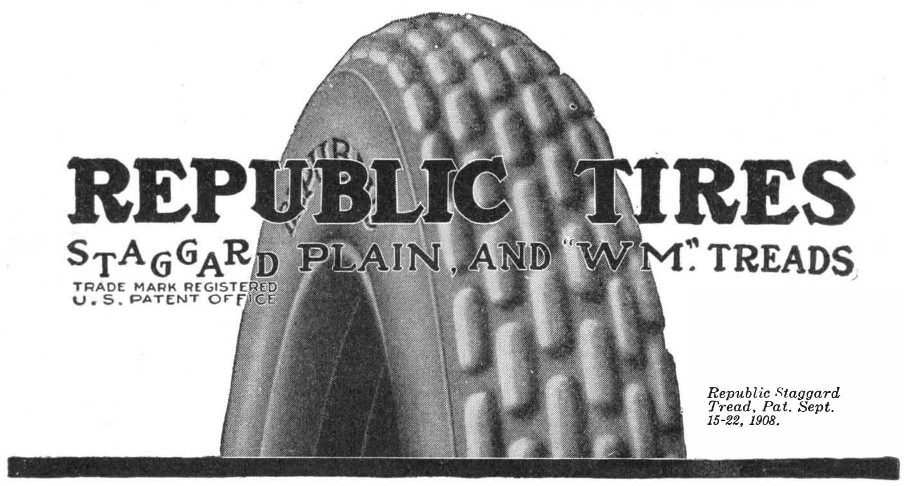
"So the Republic inventors didn't imitate, didn't attempt to construct something 'just as good.' They studied road surfaces, analyzed skidding dangers, and designed along scientific principles a tread capable of filling every requirement.

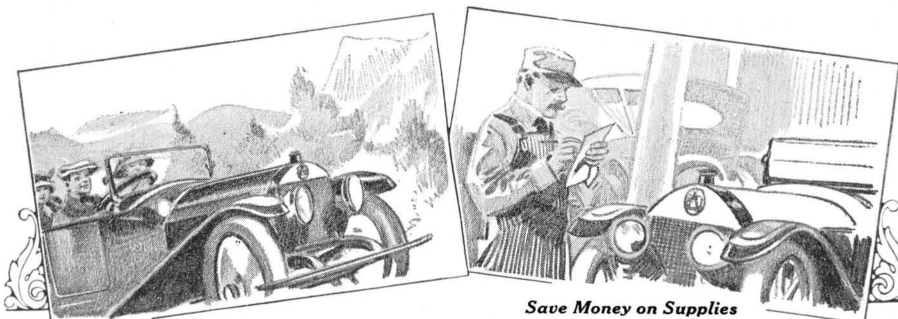
"For seven years thousands of experienced motorists have been putting it to test on slippery city pavements and hard gritty country roads. That they believe it to be the Supreme Tire Value is proved by their continuous use of nothing but Republics.

"From the standpoint of economy, too, Republic Tires will win your decision easily. They cost more to buy than many, because there's more *real quality* in them—but they cost less to use than any, because you get more uninterrupted mileage out of them."

Write for "*Old Man Mileage—His Book*," which contains facts of vital interest to every tire buyer.

**The Republic Rubber Co., Youngstown, O.**
*Branches and Agencies in the Principal Cities*



*Travel Under M.S.A. Protection*

*Save Money on Supplies*

# FREE to AUTO OWNERS
## —the Official "M. S. A." Book

Write your name, address and name of your car on the coupon and mail today for a copy of the official book of the Motorists Security Alliance. Join hands with the big national organization whose protection and service is bettering conditions for motor owners everywhere. Learn how the Little Red Bull-Dog and protection plate of the M. S. A. on your car will benefit *you*—how it protects you from theft, extortion and fraud—how it comes to your aid in emergencies—how it works for your interests in pushing the good work for good roads, fair legislation, etc

# Join the "M. S. A"— for Economy and Protection

Here are some of the big benefits which a membership in the Motorists Security Alliance secures you.


Make Substantial Savings on Supplies and Accessories

**Emergency Certificate of Identification for Credit. Best Legal Service Obtainable. Best Medical Attendance. 25 Per Cent Saving on Insurance Covering Automobile Risks. Big Saving in Supplies. Protection Plates for Your Car. Official Routes and Touring Suggestions. Prevention of Extortion.**

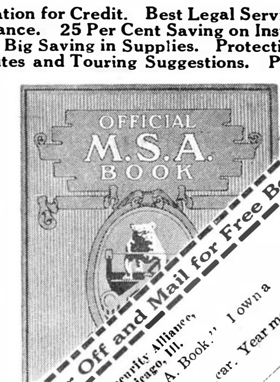
## Save Money on Supplies

Everything and anything from spark plugs to bodies supplied at a substantial saving in quick time through our Purchasing Department for members exclusively.

## Local Agents Wanted

Send for official M. S. A. Book free to auto owners. Learn what big things the M. S. A. is doing for its members. Every local agent must be an automobile owner and member of the M. S. A.

**WRITE TODAY** ☞




MOTORISTS: Tear Off and Mail for Free Book

J. Lester Williams, Sec'y Motorists Security Alliance, Dept. 25, 327 So. La Salle St., Chicago, Ill.
Please send me the official "M. S. A. Book." I own a ______ car. Year model 191__
Name ______
Address ______

16

SEVENTY-FIRST YEAR

# SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

VOLUME CXII.
NUMBER 19.

NEW YORK, MAY 8, 1915

10 CENTS A COPY
$3.00 A YEAR

## Hand Grenades

By Edward C. Crossman

Back in the days of the muzzle-loading musket used by the armies of the world, it was not surprising to find the hand grenade in common use. With the gun as slow to load as a modern coast defense gun of largest size, of little power, inaccurate, and used in a manner that deprived it of half its possible usefulness, the hand grenade was an instrument that compared quite favorably with the musket for making the gentlemen on the other side of the argument as uncomfortable as possible.

In those days the hand grenade was merely a hollow iron shell, with a fuse that the grenadier lit from his always glowing match, and then lofted into the assemblage of the persons not agreeing with his government. Sometimes it was nicely timed, and when so timed it left a considerable gap in its immediate neighborhood. At other times its targets snuffed out its fuse, or else picked it up and hove it back to its senders, which was manifestly not playing the game fair. Inside the shell, of course, reposed a quarter or half pound of black powder, which is quite sufficient to distribute jagged bits of cast iron casing with considerable celerity.

In these days, however, of rifles sighted up to 2,500 yards, and having the extreme range of 2½ miles; of clip loading magazines that enable an accurate and sustained fire of twenty-five or thirty shots a minute; of machine guns that chatter forth shots at the speed of an agitated pneumatic riveter on a steel framed building, and of long-range field guns, the mere mention of a hand grenade is sufficient to provoke snickers among the listeners. The British "Musketry Regulations," containing a grave discussion of the hand grenade and how it is to be used, was as funny as *Puck* or *Judge* to those reading it, and not believing in the possibility that 2½-mile rifles could be brought down to the dull level of trench fighting at 50 yards range.

Now with the war nine months gone, and the trenches of the Allies and their German friends hobnobbing with each other at the distance of 50 yards or so, students of warfare have made some astonishing discoveries. One of them is that while a rifle of 2½-mile range won't hit a man with his head snugly down in a pit 50 yards away, a missile cannily lofted across the intervening space into the pit, may do with the aid of gravity just what the bullet failed to do because of its failure to respond early in the game to the blandishments of the gravity siren.

The Teutons, with their usual love for thoroughness, evolved a short-barreled exaggerated howitzer of range *nil*, but of propelling power considerable. All they ask of this little gun is to heave a few hundredweight of high explosives into the air far enough for them to fall into the trenches of the other fellows a couple of hundred yards away, or even less. Here is the old hand grenade again, but of heavier weight, and with a little powder to do what the husky arm of the old grenadier used to do.

Also the true hand grenade is come into its own once more. If the belligerents keep on, we'll see the Germans advancing in Macedonian phalanx formation, and the Allies hastening out to meet them disguised as old-time Roman legions. The poor flat trajectory rifle has to hang its diminished head and confess that its very flatness of flight prevents it from curving gently over the edge of the other gentleman's home in the ground and seeking him out.

The British hand grenade, a large number of which they had in service when the war broke out, consists first of a piece of cane with a metal head on it, containing the bursting charge of lyddite, and the detonator or exploding arrangement to act when the grenade strikes. The handle and head are 16 inches long over all. Attached to the end of the cane handle is a 3-foot bit of cloth, the tail, to make the grenade fly true and insure that it strikes head first, on its detonator, after which the cute little affair takes care of itself and those around it.

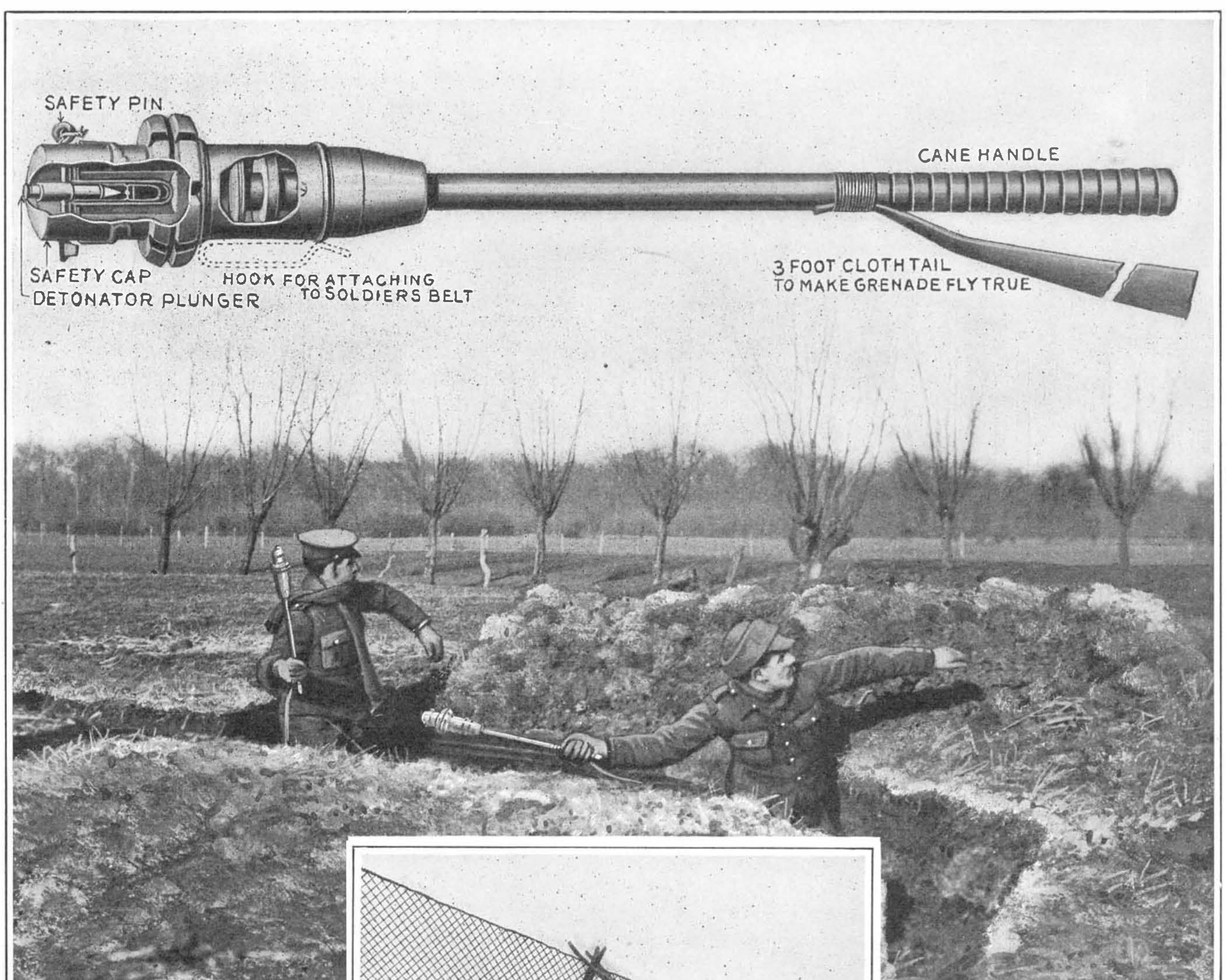
The grenade, with its detonator and its safety devices to prevent premature discharge in carrying it, form quite a complicated and expensive bit of machinery.

Normally the machine is carried by a hook, handle downward, at the soldier's belt. When the time seems ripe to transfer its affections to the other fellows, the soldier unhooks it from his belt, turns a cap at the head of the grenade until the word "remove," painted on the cap, is exposed and in line with arrows on the body of the grenade and then removes the safety cap. Then the detonator is placed into position on the side of the grenade and given a turn to lock into position in the studs provided for it.

The tail is then unwound from the handle, the cap is replaced and turned to fire position, the safety pin locking the detonator plunger is withdrawn, and the machine is ready to throw.

The soldier is instructed to throw it at an angle of not less than 35 degrees with the ground, both to give it the required range and to insure the machine hitting on its head and firing from the impact. It may be thrown under or over-handed. The soldier is told to be sure that the 3-foot tail does not become entangled with him or any other object as it leaves his hand.

In actual service the machine is always ready for service, unwinding the tail, withdrawing the safety pin, and turning the cap to "Fire," being all that is necessary.




**Practising throwing hand grenades into the enemy's trenches.**

**Net protection against hand grenades.**

The bursting charge of lyddite is sufficient to blow the steel head into bits and kill the men standing close by it. The explosive is similar in its action to guncotton, but is made of carbolic acid and nitric acid, being of a form of the better known picric acid. The French melinite and the Japanese shimose are similar explosives under another name.

The grenade differs from the old type in that it is fitted up with percussion cap or detonator, sensitive to shock, to explode on impact with anything after it is set to "Fire," while the bursting charge, due to the great improvement in explosives, is five or six times as powerful, weight for weight, as the old-fashioned black powder formerly universally used in missiles of this character.

The trench fighting in Belgium and northern France has shown the full effectiveness of these miniature bombs, and it is not unlikely that the soldiers of Uncle Sam may find themselves drilling now and then in the gentle art of heaving an infernal machine full of high explosives across a few yards of ground, instead of learning how to hit things at 1,000 yards with the out-of-date rifle.

# SCIENTIFIC AMERICAN

**Founded 1845**

**NEW YORK, SATURDAY, MAY 8, 1915**

Published by Munn & Co., Incorporated. Charles Allen Munn. President; Frederick Converse Beach, Secretary; Orson D. Munn, Treasurer; all at 233 Broadway, New York

Entered at the Post Office of New York, N. Y., as Second Class Matter
Entered as Second Class Matter at the Post Office Department, Canada.

Trade Mark Registered in the United States Patent Office




**Subscription Rates**

| | |
|---|---|
| Subscription one year | $3.00 |
| Postage prepaid in United States and possessions. Mexico, Cuba, and Panama | |
| Subscriptions for Foreign Countries, one year, postage prepaid. | 4.50 |
| Subscriptions for Canada, one year, postage prepaid | 3.75 |

**The Scientific American Publications**

| | | |
|---|---|---|
| Scientific American (established 1845) | per year. | $3.00 |
| Scientific American Supplement established 1876. | " " | 5.00 |
| American Homes and Gardens | " " | 3.00 |

The combined subscription rates and rates to foreign countries including Canada, will be furnished upon application.
Remit by postal or express money order, bank draft or check

**Munn & Co., Inc., 233 Broadway, New York**

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp* the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.


*The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.*

## Strategic Positions of the Contending Armies

IN analyzing the situation in a given theater of military operations as to the opportunities offered to armies of occupation, the first step must be to determine all the strategic possibilities, and then to eliminate those that, for one reason or another, cannot be applied to the particular case at hand. To apply this principle to the situation as it exists on the western front of the war in Europe, these conclusions must inevitably be reached:

First, that inasmuch as one flank of each army rests on the North Sea and the other on the Swiss frontier, a general flanking operation by either belligerent is impossible; second, as the country in rear of both the German and the Allies' lines is liberally checkered with both railroad lines and excellent state roads, no general movement against lines of communication or supply can be undertaken. This restricts the number of possible moves that can affect the general line to but one, a flanking operation, against a given section of the existing line, preceded by a frontal attack of sufficient power to break through. In other words, it must be a hacking operation, followed by a movement against the flank of the broken line at the point of rupture. Local successes attained through operations against a supply line are possible, and will result in a retirement of small sections of the line, as, for instance, a successful move against the Metz-Thiaucourt Railroad in the Woevre district. The cutting of this road would compel the German line from Etain to St. Mihiel and thence to Pont-a-Mousson to fall back on Metz so that from Etain the line would run east to Metz and thence south along the Lorraine border. The general effect of such a move would be practically *nil*. The Germans would occupy a hundred square miles less of French territory, but their new line with Metz in the center would be stronger than the old.

All the fighting that has taken place this spring in the northern section of the line from Armentières to Dixmude has had for its object an ultimate flanking move. St. Eloi, Neuve Chapelle, and Hill No. 60, east of Lillebeke, were all fought for the purpose of bending back the German line at these points, and, by increasing the pressure, to force the German right wing, in order to straighten out their line, to fall back to some point on the North Sea west of Ostend. The general plan followed in each case was the same. A large concentration of men and guns was made at the true point of attack. An attack was then launched against some other point. When the line in front of the true objective was weakened to reinforce the point of attack, the real attack was driven home. The present German advance along the Ypres Canal, in its final analysis is likewise a flanking move. The object to be accomplished is, first, to force the retirement of the British from Ypres, which is the key to the Yser district, and then the withdrawal of the entire left flank from Belgium, thus opening the way to Calais and the consequent command of the Straits of Dover. This move is the most important that has yet been made in the western theater since, if successful, it will be most fruitful of results. It is therefore of interest to study the conditions that will bear directly on its success or failure.

During the winter Germany has increased her field force by about five hundred thousand men. This brings her to the point of maximum strength. The losses that are now being sustained and that will be sustained as the fighting progresses cannot be replaced. Germany, as well as the Allies, is short of ammunition, and therefore for months, instead of taking the offensive, has remained on the defense and so conserved her supply until all was considered in readiness for her strong offensive effort. Many of this last levy of troops have been brought up to the Ypres-Dixmude lines and are now engaged, so there is but a small reserve on which to fall back. Germany, therefore, must succeed in the present battle or acknowledge herself unable to maintain a sustained successful offense against the Allies' line. The result must be a return to the defensive status she has occupied up to the beginning of the battle of Ypres. Her offensive power will be permanently impaired, if not destroyed. In such a contingency Germany's only hope of averting defeat will be to play for a stalemate. An army that cannot deliver a strong attack cannot know victory.

On the other hand, Germany's organization and the consequent control by her commanders of all grades over the men in the ranks is undoubtedly developed to a finer point than is the case with the Allies. This is illustrated by the difference in the result accomplished when their opponent's line has been broken. At Neuve Chapelle, St. Eloi, and Lillebeke in the rush forward by the Allies that followed the breaking of the German line, but a comparatively small advance was made beyond the German trenches before all control of the officers over their men had gone and the advance disorganized. In striking contrast was the German advance through the break in the Allies' line at Langemark. This advance was steady, systematic and well organized, and control and contact was never lost. The advance has been temporarily checked, it is true, but by the force of strong reserves brought up by the Allies, not by any inherent fault in the German organization. This is one of the most potent factors in a successful offensive engagement. Without it, the enemy's reserves, held well in hand, striking a force that an advance has disorganized and thrown into confusion, can often turn victory into defeat.

In the eastern theater of operations the situation is somewhat confusing, owing to the contradictory nature of reports issued from the various headquarters. Certain elements of the general situation are, however, known with fair accuracy. There are several separate and distinct battle lines, extending generally in a huge semicircle from the Niemen to the Rumanian frontier, where it is crossed by the Pruth River. The first line, which is involved in the operations around Warsaw, the Mazurian Lakes and East Prussia, extends from the Niemen to the Rawka River. There is then a break, the second line beginning at about the Nida River, the break being spanned by large cavalry patrols. From the Nida the line runs south to the Carpathians and then east along the crests to the Stryj River. The third line runs along the Stryj toward Munkacs. The fourth is along the Pruth, north of Bukowina Province. The only line that is really active is that section running along the ridges of the Carpathians, where the battle for control of the passes has been raging since the fall of Przemysl. Every effort of Russia and the Germanic Allies is concentrated along this line, to the almost complete disregard of the other portions of the eastern theater.

The keynote to the Carpathian battle is Uszok Pass, around which the most terrific battle of the war has been in progress for nearly six weeks. If Russia cannot force the passage of the Carpathians here, the entire Carpathian campaign will be a failure. Russian possession of the railroad is absolutely necessary as a line of supply to her army, as it moves forward down the southern slopes of the mountains toward the plain. But, judging solely on the meagre reports of this section that the censor has permitted to come through, Russia is no nearer her accomplishment than she was several weeks ago.

As matters are now, therefore, on both fronts the end of the war, in so far as it may be concluded by force of arms and not by political or economic considerations, is a long way off. There is but one factor that may hasten its end, and that is Italy's advent into the maelstrom. Italy may well prove to be the balance of power. The invasion of Austria, across the Julian Alps, by a million and a half fresh men, well equipped with artillery and plentifully supplied with ammunition, would eliminate Austria completely from military considerations and, by destroying one of Germany's main sources of supplies outside of her own borders, would do much to bring matters to a conclusion on both fronts. In any event, however, the present indications are that the west will never bring about the war's conclusion. If decided by arms at all, the decision will be made in the eastern theater.

## Typhoid Fever

TYPHOID fever has fourth place on American mortality lists, coming after only tuberculosis, pneumonia and cancer. It takes among us the place of the "Asiatic Guest," which the European peoples have from time immemorial so constantly and so unnecessarily entertained. Both these diseases are "ingestion infections" contracted in absolutely no other way than by swallowing food and drink (the latter mostly water or milk) contaminated in various disgusting ways, with either the cholera vibrio or the typhoid bacillus. Dirty fingers and the filthy fly are the chief intermediaries. Scientifically speaking, nothing can be simpler than the prevention of these infections. The application of the principles is, however, of great practical difficulty. For example, there is the cook, Typhoid Mary, a carrier of the germ, who, although she declared she never herself had the disease, has, nevertheless, in those migrations from family to family peculiar to her caste, through a number of years disseminated the infection to some score or more of sufferers. There have indeed been typhoid carriers who have had the disease forty years previously and have continued through all that time being a menace. It is computed that one fourth of the people who have had typhoid are carriers; that, disease or no disease, one in every one thousand of us is such a carrier. Most infections are self-limited; their quarantining time is fixed. But you cannot quarantine a typhoid carrier a whole life time, any more than you can frame an indictment against a whole nation. The great trouble with Typhoid Mary has been her perversity, exceeding even that which obtains in her most temperamental of callings. She has never conceded herself a menace; she has not obeyed the sanitary directions given her; she would not wash and disinfect her hands as required; she will not change her occupation for one in which she will not endanger the lives of others; under an assumed name she had competed with the Wandering Jew in scattering destruction in her path. Typhoid carriers who are amenable to reason, conscientious, careful and scrupulously clean, need not endanger anybody's existence.

However, the American people have surmounted difficulties a thousandfold greater than any typhoid fever presents. The elimination of this infection depends largely on the fact that the individual cannot protect himself without the aid of the constituted authorities. Typhoid disappears most surely in that community where such authorities know their business and are determined to go about it until they have accomplished it. And the better the citizen body hold up their hands, the quicker and the more thoroughly the beneficent job gets done.

The best insurance against typhoid is, after all, to get inoculated against the disease, as all sensible people are now vaccinated against small-pox. Especially is this well to do when there are typhoid epidemics; and for commercial travelers, motorists, tourists and vacationists who may in the most subterranean ways contract typhoid and become typhoid carriers. And since this is a disease largely of adolescence, youth and early manhood and womanhood, our young people going to boarding schools and colleges should certainly submit to this preventive measure before leaving home. It is considered that the protection is effective for at least two years, and may indeed immunize for life. When the inoculations are made in the afternoon untoward sensations are likely to have disappeared by the following noon. A series of three successive inoculations are made a week apart. Deaths have been alleged to be due to such inoculations; but in every such case the death has been found by the authorities, on autopsy, to have been due, not at all to the inoculations, but to some disease in no wise related to or affected by this anti-typhoid preventive measure.

## Radium and Cancer

EUROPE, where the popular furor about radium and its applications appeared earlier than it did here, has already been devastated by the appearance of great numbers of dishonest and fake, money-getting, radium-cure establishments conducted by persons who possess little or no radium, and have no knowledge of its use. These people promise cures, but are, in reality, unable to obtain even those palliative effects which are possible from radium. Much harm has also been done there by honest and educated enthusiasts, who have been led to premature confidence in the curative effects of radium by the excitement of witnessing the temporary relief of symptoms and decrease of tangible tumors which it undoubtedly produces even in advanced cases. Statistical evidence to support the advice and warning to seek early operative treatment has been collected by Mr. Frederick L. Hoffman, statistician of the Prudential Insurance Company of America. According to Mr. Hoffman the recorded experience of the best hospitals goes to show that earliest possible operation for cancer seems to offer the only hope for cure. These records are distinctly encouraging, and prove that at least the initial loss of life in such operations is very low.

## Science

**A Manual of the Flora of Washington, D. C., and Vicinity** is being prepared by a number of Washington botanists, under the direction of Messrs. Hitchcock and Coville, of the U. S. Department of Agriculture. It is expected that a preliminary edition, to include the flowering plants and ferns, will be published in the spring of 1916, and it is hoped that later editions will include all cryptograms.

**Leffingwell's Explorations in Alaska.**—According to the *Bulletin* of the American Geographical Society, Mr. Ernest de K. Leffingwell has completed the extensive explorations and surveys of the northern coast on which he has been engaged for some years, and is now preparing his results for publication. He has mapped about 150 miles of the coast, including many islands, on a large scale, besides making soundings in the adjacent waters and mapping the broader geographical and geological features over an inland area of about 80 square miles.

**The Yangtze-kiang.**—Some estimates of the discharge of this great river and of the amount of sediment it carries have recently been published by Prof. Konrad Keilhack, of the Berlin School of Mines, who visited the river in September, 1913, when the stage of water was unusually high. From measurements of depth made at Wusung, Nanking, and Hankow, and estimates of width and velocity, this authority concludes that the discharge below Hankow (685 miles from the mouth) amounts in time of flood to 3,500,000 cubic feet per second. The annual mean is estimated at 1,750,000 cubic feet per second. Filtration measurements made at the mouth, near Wusung, taken in conjunction with the above figures for discharge, indicate an annual transport of sediment at the average rate of 37,500 pounds per second, or a total of 584,000,000 tons per annum.

**Banana Juice for Snake-venom Poisoning.**—The latest alleged remedy for snake-venom poisoning is banana juice, according to F. W. Fitzsimons, who records in the *South African Journal of Science* that within a year past he has received cuttings from newspapers and magazines on this subject from every snake-infested country of the world. Already companies have been formed with a view to extracting the juice from the banana stem and placing it on the market as a sure cure for snake-bite. In view of the marvelous cures reported, Mr. Fitzsimons conducted a series of experiments on animals of various species, in each case injecting the venom of a cobra, puff-adder, or other deadly serpent, and administering a copious dose of the alleged antidote—before, after or simultaneously with the poison. The juice of the plantain variety of banana was also tried. No antidotal effect whatever was obtained. The author explains that in the cases reported as cures sufficient venom had not been injected to cause death, and the patient would have recovered as quickly without treatment. It is a common occurrence for large poisonous snakes to deliver a full bite and not shed sufficient venom to cause the death of even so highly susceptible a creature as a fowl. Moreover, a snake will sometimes bite at the leg of an animal or man and miss its aim, and its venom will be shed harmlessly upon the ground; then perhaps in a second or two it will strike again, this time driving its fangs home, but injecting either no venom or too little to produce fatal results. About 60 per cent of the victims of bites by venomous snakes recover without the aid of any treatment.

**Fossil Bacteria Discovered.**—Marvelous as were the discoveries of such pre-historic monsters as the Mammoth, the Mastodon, and the Stegosaurus, they are now eclipsed by recent investigations which show the most minute microbes and bacteria in fossil form. The ancestors of our modern infectious disease germs and microbes have been found in fossils of the earliest life on the earth. Fossil bacteria have been discovered in very ancient limestones collected by Dr. Charles D. Walcott, secretary of the Smithsonian Institution, in Gallatin County, Montana. For some time Dr. Walcott has believed that these bacteria existed, and mention of the fact was made before the Botanical Society of Washington on April 6th, 1915, when attention was called to their existence in association with fossil algal deposits of the Newland limestone. The belief that bacteria were the most important factor in the deposition of these ancient limestones was also mentioned by Dr. Walcott in a preliminary publication of the Smithsonian Institution. At that time, however, no definite bacteria had been discovered, but in thin sections of limestone from the collections made in 1914 the microscope now shows these very minute forms of life, some 20 to 30 million of years old. The bacteria were discovered in three sections cut from an algal form included under the generic name Gallatinia, named after the great American explorer Gallatin. The bacteria consists of individual cells and apparent chains of cells which correspond in their physical appearance with the cells of Micrococci, a form of bacteria of to-day. The world has believed that bacteria were modern forms of life but now we are made to realize that they existed in the dawn of world history, many million years ago.

## Automobile

**Keeping Car Cushions Cool.**—William A. Daniels, of Dermott, Ark., in a patent No. 1,135,161 provides at the rear end of an automobile brackets for a spring curtain roller, the shade of which can be drawn forward whenever desired and secured at the front end of the car so the cushions of the car will be protected from the sun when the machine is standing empty with the top down.

**Combined Automobile Signals.**—In a patent No. 1,135,048 A. N. Pierman of Newark, N. J., combines with an ordinary rubber bulb horn an electrically operated signal device whose circuit closure is operated within the bulb, the two parts being so constructed that when in city traffic the reed or bulb horn can be operated, while the electrically operated horn may be brought into play for use in the open country.

**Combination Lock for Trunks.**—A simple and effective combination lock for trunks or automobile boxes consists of the usual hasp lock having below it a small button carrying figures for the combination. On the plate are two imitation rivet heads spaced at each side of the main button, but one of these heads is movable. To open the lock, the combination is turned, then the left-hand rivet-head is slid to one side, and this action causes the lock to open. The combination button is of solid make-up in itself, and is further protected by the projecting rivet heads on each side. Such a device affords 1,000 combinations, and is the subject of a French patent.

**Motorcycle Batteries in War.**—The present war in Europe is the first opportunity which motorcycles have had to show their worth as light artillery. A British machine gun battery is composed of a touring car for the commanding officer, two motorcycles with sidecars, on which Vickers light machine guns are mounted; two reserve machines, which are fitted with all the necessary arrangements to have guns mounted on them, and two sidecars loaded with ammunition. In addition to the six motorcycles, there are usually three large touring cars, loaded with additional ammunition, rifles, provisions and equipment. The battery is accompanied by a lieutenant on a very fast racing motorcycle.

**Safety Tire Valves.**—Among the things "not to be invented" should be listed so-called "safety tire valves," which are designed to permit only a maximum pressure of, say, 75 pounds, at which the valve opens enough to let a certain quantity of air in the tire escape. Tire experts call attention to the fact that if a car is left standing for a couple of hours, as often happens, with one or more tires in the direct glare of the sun, the pressure in these tires, due to the heat is liable to rise far beyond the "danger point." If the tire valve opens at this time, and the sun sinks beyond the house tops later on, permitting the tire to cool off thoroughly, the tire is more likely to be run insufficiently inflated.

**Heavy Trucks and Bridges.**—One of the most gratifying results of the present war excitement in Great Britain is the action of the House of Lords, providing for a general strengthening of the bridges along the main roads of motor traffic. These bridges were mostly under the management of the big railroad companies, and the heavy truck traffic did not appeal to them enough to cause them to expend either money or labor in strengthening the bridges. The heavy traffic in motor trucks for the British War Department has brought the question of strong bridges vividly before the people, and strong pressure is being brought by the courts, officials of the government and the press on the railroads. The result is that bridges are rebuilt all over the country.

**Finding Tire Punctures.**—An ingenious little device known as "detective" serves to localize punctures in bicycle tires and can even be used on automobile tires. It is no longer required to immerse the air chamber in water, this being often very inconvenient or even impossible to carry out; neither is it necessary to remove the pneumatic tire from the wheel, for the small device is run along the surface until the leak is found. The 'detective" is a small metal box of suitable shape whose under side embraces the tire and here is closed by wire gauze. Radially the box is divided into four or more compartments and in each one is a small amount of very light down which the slightest wind causes to fly up. When brought upon the leak, the pressure of the air acts upon the down, and this localizes the leak at once.

**Europe Will Be Flooded With Cars.**—American motor cars are to be thrown into Europe, particularly into Germany and France, immediately after the war is ended, in a manner which will make all former American "invasions" pale into insignificance. One of the largest of the automobile companies is known to be preparing to send no less than 10,000 touring cars and roadsters into the German market, within a month after the war is ended. Other companies plan a like invasion, and the export business in American motor cars will be such as simply to swamp the factories. Great Britain already sees the writing on the wall and frantic appeals come from the trade press and the dealers to the large manufacturers, imploring them to try to produce a small, standardized car in large quantities, to sell for about $700 or less.

## Astronomy

**The Royal Observatory of Belgium,** at Uccles, near Brussels, is the most important astronomical institution lying within the "war zone," and, as we have previously recorded, its activities have been partially maintained by its German captors. Its late Belgian director, M. Lecointe, has written a letter to the French Academy of Sciences stating that he is now interned in Holland. He had served in the war as a major of artillery in the Belgian army, and took part in the retreat from Antwerp.

**Transit of One Star Over Another.**—A note by Prof. Wolf, of the Königstuhl Observatory, describes the rather unusual case of a star which has been carried, by its proper motion, directly over another, as seen from the earth, within the last few years. The eclipsing star is of the 13th magnitude, and has the somewhat rapid proper motion of more than a second of arc per annum. The eclipsed star, of 15th magnitude, was formerly southeast of the other but is now on the opposite side of it.

**A New Harvard Photographic Map of the Heavens.**—It is announced that Harvard College Observatory will publish a new photographic map of the entire sky, consisting of prints from negatives taken at Cambridge and Arequipa. This set of charts will, in a sense, supplement the set published some years ago, as the center of each plate in the new series will coincide with the corner of a plate in the former one, thus bringing out many faint stars which failed to appear at the corners of the large field (30 degrees square) on account of distortion. The original series comprised 55 plates and showed about 1,683,000 stars, ranging down to the 11.5 magnitude.

**A New Spectrum Line was Shown by the Solar Corona,** as photographed at certain stations during the eclipse of August 21st, 1914. The Spanish party at Theodosia, in the Crimea, secured a spectrogram on a plate taken 13 seconds after the second contact, with 12 seconds exposure. This shows a new line the computed wave-length of which is 6,378.87 ± 0.036 A. A note in the *Comptes rendus* on the results of the expedition from Meudon Observatory, which had its station at Strömsund, Sweden, states that the plates taken there show a brilliant and intense new radiation in the red part of the spectrum, the measurement in this case being given as 6,374.5 ± 0.2 A.

**Lowell Observatory Photographs of Saturn.**—Photographs of Saturn taken at the Lowell Observatory on March 12th, both by the director and Mr. E. C. Slipher, confirm visual observations in revealing that Cassini's division is visible in part above the contour of the ball by about four tenths of its true width. This enables the oblateness of Saturn to be deduced from the photographs, a preliminary reduction of which shows that oblateness to be about one ninth. As the required visual observations are of the greatest delicacy and demand for such detections the most favorable conditions, the possibility of making photographs of this order of nicety is an advance both of scientific and general interest.

**Comparative Drawings of Mars.**—One of the most important contributions that has yet been made to the fascinating question of the Martian canals is Prof. W. H. Pickering's Eighth Report on Mars, published in *Popular Astronomy* for April. Early in the year 1913 it occurred to this astronomer that it might be a good idea at the following opposition to secure from several recognized experts simultaneous and independent drawings of the planet, and to compare these, as one step toward determining just how much may be regarded as definitely known regarding the markings on the Martian surface. More specifically, it appeared desirable to obtain a permanent record of the planet's appearance at the coming opposition, for comparison with similar records in connection with all future oppositions, since it is known that the surface changes from one opposition to another, independently of its seasons. The observers who took part in this programme were Rev. P. E. R. Phillips, Ashtead, Surrey, England; Messrs. Lowell and Slipher, Flagstaff, Ariz.; Prof. A. E. Douglass, Tucson, Ariz., and Prof. Pickering himself, at Mandeville, Jamaica. The drawings, which are published with the report, represent aspects of the planet corresponding to central meridians of 0 deg., 60 deg., 120 deg., 180 deg., 240 deg., and 300 deg. Martian longitude. They are surprising both in their agreements and in their differences. As usual, many more canais were seen at the Lowell observatory than elsewhere. Twenty-four canals were so clearly seen and accurately drawn by the three other observers as to leave no doubt of their being identical in the several drawings. Twenty-one were seen by two observers, and thirty-five by one—apart from the Lowell observations. The drawings reveal an interesting case of shifting canals, Gigas and Tartarus having apparently traveled some 300 miles across country in about three weeks. Prof. Pickering mentions previous cases of shifting canals, including one recorded by Schiaparelli. "Such observations," he remarks, "while perhaps favorable to the idea of intelligent direction upon Mars, do not strengthen the theory of irrigating ditches."

# A Mother Ship for Submarines

## A Combined Salvage and Drydock Vessel

By Robert G. Skerrett

EIGHT years ago the Fiat-San Giorgio startled the naval world by turning out submarines capable of making fourteen knots an hour on the surface. Since then they have shown engineering initiative in inventing and building a special type of dock designed for the testing of submarines at the surface but simulating all of the hydrostatic conditions incident to deep submergences, thus doing away with the uncertainties characteristic of the ordinary method of testing these boats for water-tightness by lowering them, without anyone aboard to locate leaks, in waters 200 feet deep. The Laurenti dock has already proved its value in Italy.

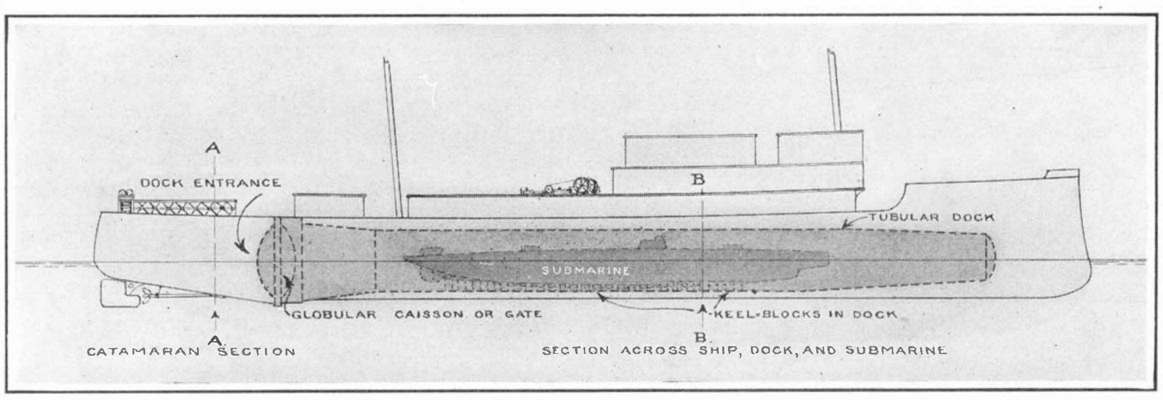



**Fig. 1.—Diagrammatic view of ship, showing position of submarine in the testing dock.**

Now, the same progressive firm has designed and built an extremely novel mother or station ship for submarines, and again the Italian engineers have blazed the way. This new craft is at once a supply base, a place for the refreshment of the wearied crews of submarines, a repair base, a testing and dry dock, and a speedy salvage vessel capable of raising one of her sunken flotilla and able to carry the injured craft into port. Other nations have salvage ships for submarines, but there their utility commonly ends, and besides, they are clumsy and of very moderate radius of action and speed.

As a basis for this many-sided adjunct to submarine service, the designers planned a mother ship for a flotilla of six submersibles, each of about 370 tons submerged displacement, the idea being that while four of the boats should be actively engaged, two of the group could be held in reserve and made thoroughly fit for relieving their active sister craft. Thus, if occasion required, all six of the submersibles could be sent to sea, but under normal circumstances a third of the force could be undergoing repairs or receiving any other attention which the exigencies of their duties might impose.

The mother ship in question is a craft having a normal seagoing displacement of about 3,000 tons, capable of developing a sustained maximum sea speed of fourteen knots an hour, and at a cruising speed of ten knots an hour carrying sufficient fuel to give her a radius of action of 4,000 miles. The vessel is fitted with twin screws, and each shaft is actuated by a heavy-oil Diesel motor developing something like 1,100 horse-power, these motors using the same fuel as that which she carries in her supply tanks for refilling the fuel chambers of the submarines. Indeed, the idea is that the men qualifying for submarine service shall first learn the management of the mother ship's internal combustion engines by way of a preliminary training, the operation of the motors for the under-water boats being substantially identical.

In order to save the motive mechanisms of the submersibles as far as possible, the mother ship will charge the batteries of the submarines as well as fill their flasks with compressed air, and will hold in reserve enough cells completely to refit two submarines in a few hours. The station ship will have a machine shop and foundry provided with facilities that will make possible all ordinary repairs, and she will carry a large supply of reserve fittings in addition to a store of thirty-six torpedoes. The mother ship has a battery of six powerful rapid-fire guns and should be quite strong enough to hold off a flotilla of destroyers. The mother ship will have a complement of 131 and, in addition, have ample accommodations for 120 men from the submarines. She likewise boasts a commodious sick-bay.

The ship has two hulls, the outer one of homogeneous iron, and the inner and cylindrical hull of high-tensile steel. This inner hull is really a Laurenti testing dock such as the SCIENTIFIC AMERICAN has already described. This tubular structure has an over-all length of 210 feet and a diameter of 23 feet, with available space for the housing, testing, and repairing of a submersible 190 feet long. The forward end of this ship-encased dock is permanently sealed, but the after end is provided with a globular caisson which can be removed and swung aside so as to flood the cylinder and to admit a submarine. The under-water boat reaches this dock entrance from the stern of the mother ship, which at that point is of a catamaran build. The cross-section *A* illustrates this, while section *B* shows the dock farther forward and a submarine resting upon the blocks.

With us, it is customary to subject our submarines to but one deep-water test, and thereafter the Navy Department takes it for granted that the boats will be able to withstand hydrostatic pressure 200 feet under the surface of the sea should accident take them there at any time during their active careers. This does not take into account the structural weakening due to wear and tear. Our submarines should be frequently tested under conditions of deep submergence, but this is impracticable with our existing facilities. But if we had a ship such as we have been describing, one that could be sent from base to base with regularity or reasonable frequency, then all of our submarines could be tested safely and speedily with all of the crew aboard, or with enough observers inside, who could watch for leaks and test valves and pumps and other emergency apparatus under conditions physically duplicating those of deep submergence. In this fashion, any ill effects of time and service could be readily detected and promptly remedied without waiting until the hour of accident to disclose the fatal yielding.

For salvage duty, the mother ship is equipped with a number of powerful windlasses for lifting a sunken submarine. In addition to these, she carries two special boats for diving service and, of course, all of the needful suits and apparatus for the divers themselves. The loss of the "F-4" and the manner in which the salving of that craft has limped should emphasize our own need of a mother ship or mother ships patterned after the sort the Italians have given to the world.

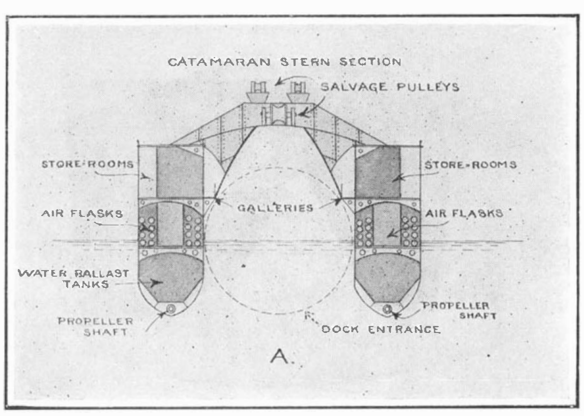



**Fig. 2.—Section on AA Fig. 1, showing dock entrance.**

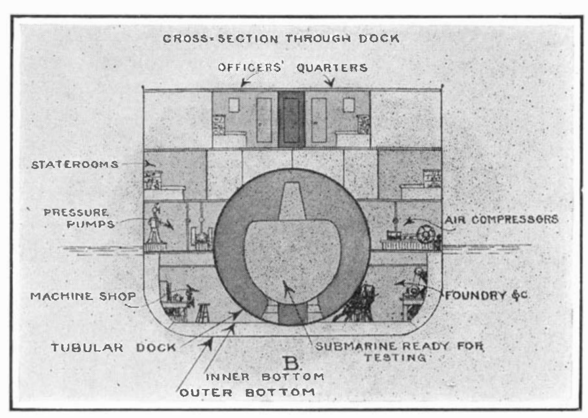



**Fig. 3.—Section through dock taken on BB Fig. 1.**

### War Then and Now

IN the course of a debate in Congress recently, Representative I. R. Sherwood of Ohio took advantage of the opportunity to tell the House of his experiences in the war of the rebellion, and he drew interesting comparisons between the way war was conducted fifty years ago and present practice; but toward the end he apparently forgets the changed conditions that he was discussing. He said:

"I carried a musket that was estimated to kill at 800 yards. I would load that musket by five motions. I carried forty rounds of ammunition, every round done up in brown paper; and the man who passed the examination then as a volunteer had to have a good set of front teeth in order to tear the brown paper from the cartridge. Now, a European soldier can pass an examination if he has no teeth at all. They are now carrying a gun that will shoot to kill at 2,000 yards. That gun will shoot ten times as frequently and is ten times as destructive as the guns the volunteers carried fifty years ago.

"Our field cannon—the largest that we carried—was a 20-pound Parrot gun. Now they are using a gun that will carry for six miles. Our guns were all muzzle-loaders. Now the man who operates a machine gun is behind armor plate; he is protected. Our trenches were thrown up over night. Now they are having trenches built from five to six feet deep, and they are covered with an impervious substance to prevent the havoc of exploding shells. Our armies on both sides were in clear view of each other. Now the armies on both sides are all out of sight, not to be seen.

"Let me call your attention to this fact, that to-day the two armies confronting each other in France and Belgium and the two armies confronting each other on the Russian border have not practically changed their positions for two months. What was the truth about our army in the great civil war? Take the army of Gen. Sherman, whose base of supply was at Louisville, Ky. It fought its way first to Nashville, from Nashville to Chattanooga, from Chattanooga to Rocky Face Mountain, from Rocky Face Mountain to Atlanta, from Atlanta to Savannah, from Savannah up the coast to Raleigh, to the close of the war. How many miles did that army march? Eleven hundred and twenty-five miles. In the Atlanta campaign of 110 days we made an advance of one mile a day—110 miles from Rocky Face Mountain to Atlanta in 110 days.

"Here is another consideration. How many distinguished major generals and brigadier generals have lost their lives in this war? Is there a gentleman on this floor who can name a single brigadier or major general who has been killed in battle in this gigantic European war? They have a line over 100 miles long in the army of the west and over 100 miles long in the army of the east. They have a battle line of over 209 miles, and we read of desperate bayonet charges every day. There cannot be any successful bayonet charges when they carry guns that will kill at a mile, because every column would be annihilated before it reached half a mile. If I were a betting man, which I am not, I would bet my month's salary against a Panama bond that you cannot find five soldiers in any field hospital in France, or Germany, or England, or Russia, or Hungary who are wounded with bayonets. We read of the terrible destruction in these battles. They have fought forty great battles, according to the reports. I venture the assertion that they have not lost 25 per cent of their armies in battle.

"Why, my friends, at the battle of Franklin, where I happened to be just at the right of the Franklin Pike, in a battle line of two and one half miles, twelve Confederate generals were killed or mortally wounded, all on the front line of battle, in five hours' fighting. Do you know of any general being killed while leading a charging column over in this European war? There is quite a characteristic difference therefore between the commanders of our armies in the civil war and of those over across the ocean."

---

**The Occultation of One Jovian Satellite by Another** is a somewhat unusual phenomenon. An instance observed November 3d, 1914, at the Observatory of Juvisy is recorded by M. Quénisset in *L'Astronomie*, with pictures of the successive stages. For about 20 minutes the two disks were seen as one.

## Measuring Atmospheric Comfort

IT is well known, even in non-scientific circles, that human estimates of temperature often differ markedly from the records of the thermometer, and that this instrument is a rather poor index of atmospheric comfort. The human sensation of temperature depends, to a great extent, upon the rate at which heat is dissipated from the body, and this is regulated not merely by the temperature of the surrounding air, but also by the humidity and the air-movement. Some years ago United States meteorologists introduced the expression "sensible temperature," to denote the temperature felt at the surface of the human body; whether regarded as a subjective phenomenon, which may be estimated according to an arbitrary scale of sensations, or as the actual temperature of the skin, as measured by a thermometer in contact with the latter. In the United States the sensible temperature was at one time regarded as identical with the reading of the wet-bulb thermometer, but this idea has now been discredited.

About ten years ago Mr. W. F. Tyler of the Chinese customs service published extensive observations on the subject of comfort and discomfort under various meteorological conditions and introduced the term "hyther" to denote the combined effect of temperature and humidity. Prof. Cleveland Abbe of the Weather Bureau has also investigated what he calls the "curve of comfort."

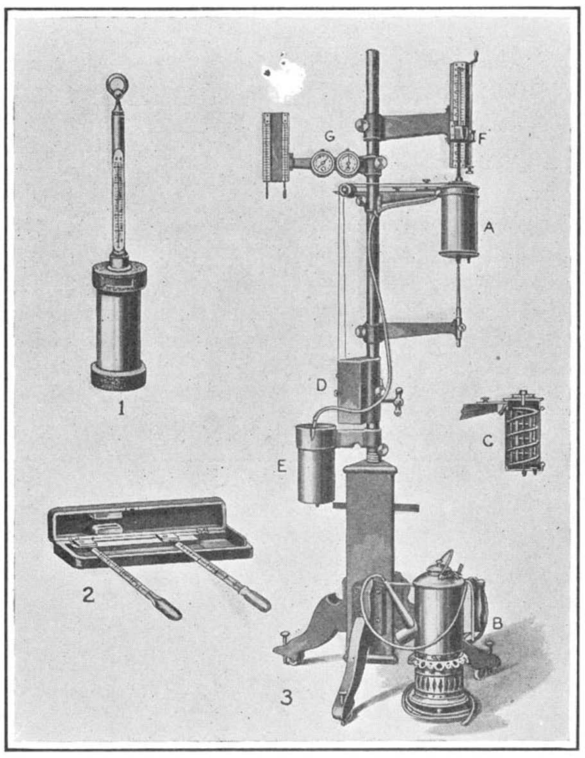
The last annual report of the U. S. Public Health Service records some investigations made under the auspices of that service at the Boston Institute of Technology, in co-operation with the New York State Ventilation Commission, upon the physical factors which influence the dissipation of heat from the body. In this connection an instrument has been devised at the Hygiene Laboratory in Washington for recording the state of atmosphere as it affects this process, which, says the report, "is a complex function of humidity, temperature, and air-movement; and the instrument in question, called the 'comfortimeter,' has for its object the proper balancing of these factors, and the recording of a single index of comfort." The instrument is not yet perfected.

Although not mentioned in the report in question, it is a fact that a large number of instruments for measuring atmospheric comfort have already been devised by various experimenters. One of the most ingenious of these was constructed forty years ago by John W. Osborne of Washington, who described it at the meeting of the American Association for the Advancement of Science in 1875. Osborne also stated the problem of measuring atmospheric comfort, or sensible climate, with a lucidity that has never been surpassed. "The body of a healthy man," he says, "is a mass of hot matter, cooling, and having lost its heat perpetually supplied by physiological changes, in quantity sufficient to maintain a uniform thermal standard of about 98½ deg. Fahr. And, whatever the causes of this loss may be, we say when it is rapid that the weather is cold, and when slow that it is hot. In the one case the functions are called upon to make up the deficiency rapidly, and in the other to facilitate the dispersion of the body's superfluous warmth."

In order to measure the very irregular fluctuations in the dissipation of heat under the influence of varying atmospheric temperature, humidity and wind, from the body, and hence the difficult task performed by the human organism in maintaining a constant internal temperature, Osborne constructed the apparatus shown in Fig. 3. Here *A* is a cylinder of "bond" or bank-note paper, supported by a brass frame. This is filled with hot water from the vessel *B*, while an agitator inside the cylinder (shown separately at *C*), which is kept in motion by clockwork, *D*, mixes the water and keeps its temperature uniform throughout at a given moment. *E* is an overflow attachment. By means of the thermometer, *F*, and a pair of stop watches, *G*, the rate at which heat is lost from the wet surface of the porous paper can be accurately determined. Osborne's observation with this instrument demonstrated the striking differences that often exist between the rate of heat-loss from the cylinder (representing the human body) and the temperature of the air as ordinarily measured.

Quite analogous was the "deperditometer" of A. Piche, which consisted of a porous vessel containing water, the temperature of which was maintained constantly at blood-heat (98.6 deg. Fahr.) by a gas jet provided with an automatic regulator. The amount of gas burned in a given time served as a measure of the cooling power of the atmosphere. The problem was taken up anew by Dr. J. R. Milne, who published in 1911 a description of his awkwardly named "psuchrainometer," which also measures the loss of heat from a surface kept at 98.6 deg. Fahr., but uses electrical heating and measurement.

In the same year (1911) Dr. F. Frankenhäuser published in the *Zeitschrift für Balneologie* an account of an instrument called the "homœtherm" (Fig. 1), for measuring the cooling effects of the atmosphere under different conditions of temperature, moisture, wind, solar radiation, etc. This consists of a small copper cylinder, filled with water, in which is plunged the bulb of a thermometer. The cylinder is heated over a lamp and then exposed in the atmosphere to be tested. The instrument is so constructed that a fall of one degree registered by the thermometer corresponds to a loss of one gramme-calorie of heat per square centimeter of exposed surface. The cylinder may be covered with a cotton jacket, either dry or wet, to represent the clothed human body and the effects of wet clothing. With this instrument Frankenhäuser found that the wind movement accelerated cooling more rapidly than a marked fall in the air temperature. His experiments indicated that temperature is a far less important factor in climate, from a hygienic point of view, than is generally supposed. His apparatus can be arranged for continuous observation, with permanent registering and heating apparatus.




**Measuring atmospheric comfort.**

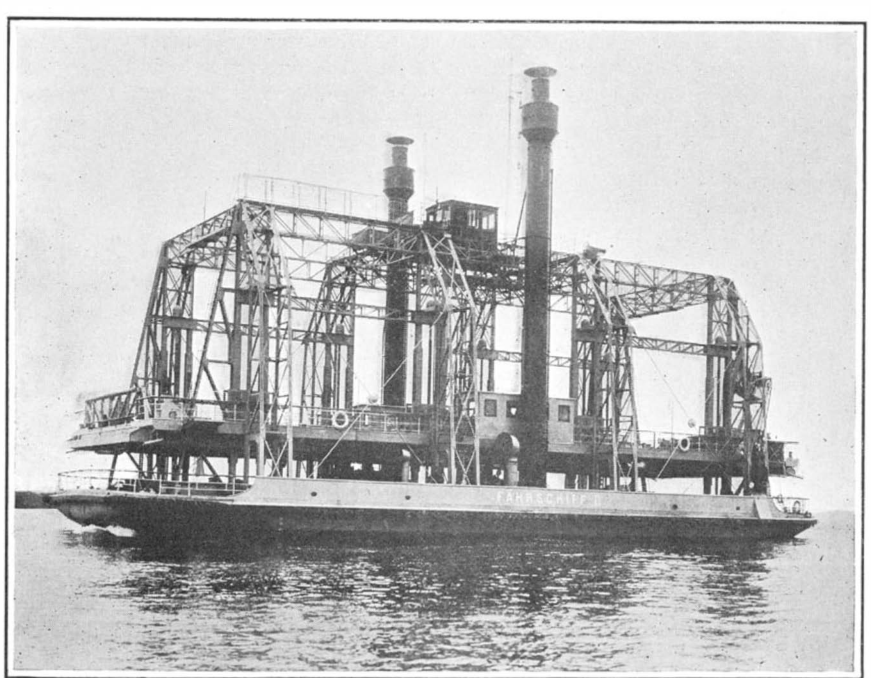
Finally, Prof. Leonard Hill has recently invented two instruments of this class. One, called the "caleometer," which he devised in collaboration with O. W. Griffiths, consists of a small electrical furnace automatically kept at body temperature, and an indicator which shows in calories the energy required to keep it at that temperature. It thus indicates the rate of cooling. Hill's other invention of this class is the "katathermometer" (Fig. 2), which utilizes two large-bulbed thermometers. The bulbs are both warmed to 110 deg. Fahr. in warm water. On removing from the water, the bulb of one is dried and the other left moist, and both are allowed to cool, the time required to fall from 100 degrees to 90 degrees being noted. The wet bulb loses heat by evaporation; the dry by radiation and convection. On an ideal spring day the wet bulb has been found to take 45 seconds, the dry 2 minutes and 20 seconds. The ventilation and heating in a room should, accordingly, be arranged so that the thermometers will cool at these rates. Prof. Hill and his collaborators at the London Hospital Medical College are now organizing a corps of volunteer observers with the katathermometer in British town and country districts.

## The Power of Projectiles

IN the course of some remarks by F. W. Lanchester recently in *Engineering* he gives the following interesting facts in regard to the power of rifle bullets. The kinetic energy of a projectile commonly represents from 10 per cent to 30 per cent of the total energy of the explosive or powder charge by which it is projected; the lower figure corresponds to the performance of a small-bore low-velocity rifle, the latter being that approached under the most favorable conditions by the military or big-game rifle. The British Service rifle with Mark VI ammunition thus has an efficiency of approximately 28 per cent; in the ordinary sportsman's "12-bore" the figure is about 11 per cent. The total energy released on combustion by black powder is the equivalent in round numbers of 500 foot-tons per pound. The corresponding figure in the case of cordite is half as much again, or approximately 750 foot-tons per pound; and in general it may be taken that most of the explosives in common use have an energy content between 500 and 1,000 foot-tons per pound. In the case of the Service rifle the weight of the powder (cordite) is 30 grains (0.0043 pound), and the bullet 215 grains (0.0307 pound), and the velocity 2,050 feet per second. Thus the total energy of the charge is $0.0043 \times 750 = 3.2$ foot-tons, and the muzzle (kinetic) energy is 2,000 foot-pounds $= 0.895$ foot-ton; the efficiency, therefore, is $0.895/3.2 = 0.28$, as already given. It is worthy of remark, *en passant*, that there is very close accord between the figures applying to the gun and those which obtain in the gas-engine in all such matters as efficiency, heat lost to barrel (cylinder walls), and heat remaining in gases. The agreement is far closer than one would have ventured to expect in view of the great disparity in the conditions.

## Ferry With Elevator Deck

THE steam ferry which is now in use at the port of Hamburg is of a somewhat original type, although there is one of somewhat the same kind employed in England. As our photograph shows, the originality consists in the use of a main deck which can be raised and lowered by suitable machinery in order to take up a difference of level of some sixteen feet. The large structural framework rises to a considerable height, and is intended to guide the whole platform in its vertical movements. By the use of powerful electric winches it is possible to raise and lower the deck as a whole, even when it is loaded with numerous heavy vehicles, such as are used in landing material at the port. The reason for adopting this arrangement of the deck lies in the fact that at the Hamburg port the difference in tide level is considerable, so that when the boat lands at the wharf it is by no means on the same level at all times, and in the ordinary case the heavy vehicles would be obliged to mount or descend a steep incline. It is in order to avoid this drawback that the present type of ferry was constructed, and as the movable deck can always be brought flush with the level of the dock, the vehicles can now run off in the ordinary way. The present ferry has a displacement of 190 tons and is about 110 feet in length. Triple-expansion steam engines of 640 horse-power run it at good speed, and it is now doing excellent service in the port. It was found best to construct a small special slip for the ferry, so that it can land without being interfered with by the wash produced by other boats. The boat is equipped with a very complete and modern electric outfit both in the way of lighting and motors for the various services.



**Ferry deck that may be raised or lowered to compensate for tides.**

## More Dogs Wanted by the German Army

ACCORDING to the Berlin *Lokal-Anzeiger*, the German army possesses 1,200 dogs, trained to find wounded men on the battlefield, and many lives have been saved by these faithful and intelligent animals. The military authorities have called for 400 additional dogs and a civilian society, formed for the purpose, has issued a fervent appeal to owners of dogs possessed of capability of the requisite training to send in their dogs, and to accompany them as keepers and trainers, if possible. Funds for the support of this humanitarian service are also urgently needed.

## Plan for the Improvement of Hell Gate, East River

By C. D. Ward

SINCE 1852 a great amount of work has been done by the United States Government to improve and deepen the waterway of the East River by removing reefs, rocks, etc. In 1868 it was decided to deepen the channel to 26 feet and, up to 1911, about $5,000,000 had been expended and 58 per cent of the necessary work had been done.

The Government later became convinced that the outlet from the New York harbor to the Long Island Sound was so important to the growing commerce of the city that it required a channel 35 feet deep in the East River to accommodate the larger vessels. To make this 35-foot channel of proper width, extending from the Battery, at the south end of Manhattan Island, to North Brother Island, where a deep channel is found, needs at many points to have rocky reefs and ridges removed, at a total estimated cost of $10,000,000. Even after the channel is thus deepened and widened the tidal currents would still be rapid, especially at Hell Gate, and, at certain times of tide, dangerous to navigate on account of the 6.7 to 8.5-mile surface currents, accompanied by violent eddies, at that part of the channel between Negro Point Bluff on the north and Hallets Point and Mill Rock on the south. On this stretch the river takes two right-angled turns, as shown on the accompanying map, which produce the violent eddies which are the cause of difficult navigation and of many accidents and wrecks.

The East River, both above Negro Point Bluff and below Hallets Point, widens out considerably, and the effect is that at a certain time of the flood tide (running north) the surface of water at Hallets Point is reported to be 1.2 feet higher than the surface at Lawrence Point, north of Negro Point Bluff. On the return tide the conditions are reversed. These great differences of level, in the short distance of about a mile, show plainly the cause of the rapid currents through the crooked and contracted channels.

The whole volume of the East River, however, does not pass Negro Point and Hallets Point, but part of it flows through Little Hell Gate, which has a present section given as 3,060 square feet, and another small part flows through Harlem Kills with a present section of only 970 square feet at low tide. The water flowing south or west through these two passages joins the south part of the Harlem River and so joins the main stream of the East River just west of Hallets Point with a small portion flowing off to the west through the Harlem River and so to the Hudson River at Spuyten Duyvil. The return tide, of course, follows the same reverse route. To reduce the violence of this current, the writer would advocate the opening of Harlem Kills to an increased width of 600 feet and 24 feet deep, and give thereby a wide channel for free navigation direct from the Harlem River to the Sound and greater flow of water to reduce the present direct current through Hell Gate. This widening of the cut to 600 feet would give a waterway of 14,400 square feet instead of 970 square feet, as at present.

Turning now to consider the contracted channel at Negro Point, it seems difficult to widen the channel materially where the New York connecting railroad bridge is to cross, as the abutments for the large arch span are already built, and with a boulevard also between the east abutment and the Long Island shore, which boulevard has to be taken care of; still, the channel being very deep in the center and shallow at each side, the writer thinks it very feasible to deepen the waterway at each side, say to 50 feet, and to also widen it somewhat and thus increase the present section of the channel from 47,316 square feet, as given by the Government engineers, to 55,800 square feet. This would materially help to reduce the velocity of the current at that narrow point. To obtain this same enlarged section north and south of the railroad bridge, the present bulkhead lines would have to be somewhat changed and, especially on the Ward's Island shore, some of the upland excavated as well as the channel deepened, as shown on the map. The cost of this deepening of channel is uncertain, owing to the limited amount of data accessible to the writer, but we will assume it would be $1,000,000.

The cost and efficiency of the plan, the writer would hope to be approximately as shown in the accompanying table.

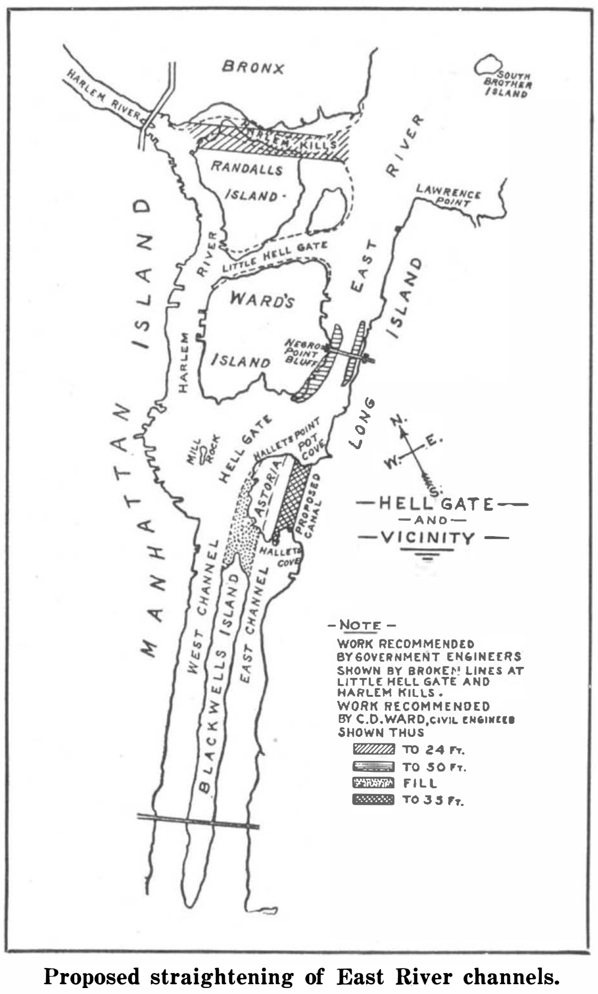
The writer would, in addition, advocate an almost forgotten plan to cut a canal through Astoria, from deep water in Pot Cove to deep water in Hallets Cove, as shown on the accompanying map.

This canal is the main and important feature in the writer's proposed plan and would give a direct and straight course from Negro Point to the East Blackwell's Island Channel without the present abrupt turns. This is not so expensive a work as at first appears. The land required for this proposed canal is now assessed, with buildings, at a valuation of $1,029,000, and would possibly cost the Government $2,000,000.

| | Present Section | The Writer's Plan | |
|---|---|---|---|
| | Square Feet | Section Sq. Feet | Cost |
| Harlem Kills | 970 | 14,400 | $6,041,571 |
| Little Hell Gate | 3.060 | 3,060 | .......... |
| East River at Negro Point | 47,316 | 55,800 | 1,000,000 |
| Totals | 51,346 | 73,260 | $7,041,571 |

This table shows an increased area of combined water-way of 22,000 square feet, which would reduce the maximum mean velocity of the current at Negro Point in Hell Gate, from 4 miles per hour to 3 miles per hour and the surface velocity proportionately.

The writer considers that the canal should be made 500 feet wide, although a less width might do, and 35 feet deep at low water, looking to a possible deepening of the channel east of Blackwell's Island to 35 feet when commerce demands it. It is now expected the Government will deepen the eastern channel to but 20 feet, though the Government engineers advocated 26 feet, which depth at least would very naturally follow if the canal should be cut. Excavating the canal would be a large undertaking but a simple one, as it would be taken out as a dry cut entirely at small unit cost, and should not total over $2,000,000 for excavation and wasting.




**Proposed straightening of East River channels.**

The regular course for boats navigating the East River would then be to go north up the channel on the east side of Blackwell's Island and direct through the canal and Pot Cove and so directly on past Negro Point. Boats southbound to go by Negro Point and Hallets Point and the channel west of Blackwell's Island, as all do at present, thus making navigation very safe and avoiding collisions, though vessels could go both up and down either channel, if preferred.

Another very great benefit of the canal would be the large reduction in the maximum mean velocity of the current at Hallets Point, which would probably be reduced to about two miles per hour, owing to the large portion of the flow diverted through the canal.

The cost of carrying out the writer's proposed plan would be approximately as follows:

| | | |
|---|---|---|
| Widening and Deepening Harlem Kills to 600 x 24 feet | | $6,041,571 |
| Widening and Deepening channel at Negro Point | | 1,000,000 |
| Total by Writers Plan not including Canal | | $7,041,571 |
| Cost of land at Astoria for canal | $2,000,000 | |
| Cost of Excavating and Wasting Material | 2,000,000 | |
| Total cost of canal of 500 feet by 35 feet | | $4,000,000 |
| Total estimated cost of Writer's plan | | $11,041,571 |

It is understood that this estimate does not include deepening the channel at Hallets Point Reef, Pot Rock, Ways Reef or East B. I. Channel as they are included in the general estimate of the Government engineers for deepening the East River channel.

The writer considers the advantages of his plan to be:

First: A reduction of velocity of current at Negro Point, reducing a four-mile maximum mean current to a three-mile current. The surface current would be reduced in proportion.

Second: The use of the canal would make it feasible to use the two channels at Blackwell's Island, as follows: the east one to be use by vessels going north, avoiding collisions and the dangers of Hallets Point; the west channel for vessels southbound, first passing Hallets Point with little danger either from violent currents or eddies which now cause so many accidents or collisions with other vessels at that point. This would certainly be a great benefit to the navigation of the East River.

Third: The effect of drawing off the large body of water through the canal will be to reduce materially the amount left to pass Hallets Point and to probably reduce the maximum mean velocity to two miles per hour at that point.

Fourth: Opening the Harlem Kills, giving a direct and free connection between the Harlem River and the Sound.

Fifth: The estimated cost of this plan is believed to be less than by any other equally effective one.

Finally: It would seem that the great advantages of this proposed plan will so appeal to the shipping and commercial interests of this metropolis that, in spite of the large expense and the objection always made to condemning private property for public use, they will demand that this most comprehensive plan be carried out.

With the East River Channel deepened and widened as proposed by the Government engineers and the writer's suggested improvements made, our largest battleships could then safely pass up the East River and out by the Sound to the ocean.

Cutting this proposed canal would make an island of about 25 acres in extent of that part of Astoria to the west of the canal, which land is assessed at a valuation of $1,303,800 and might cost $2,500,000 to purchase, not including an athletic ground for public school children at Hallets Point, the assessed valuation of which ground and buildings is $105,000 and covers about 2.5 acres, and is already owned by the city of New York.

This island would be very undesirable for residences or factories after the canal was cut, without a bridge across the canal to connect it with the main part of Long Island. A bridge would not be thought of, of course, and so it would be proper to change the landing of the present ferry from its present site at the foot of Fulton Street, Astoria, to the vicinity of Pot Cove near the new park, and also it would seem necessary for the city of New York to join in the improvement and buy part of the proposed island which it does not already own, to be used for a park or institution.

It is understood that Blackwell's Island is at present crowded with its various institutions and an enlargement of the island would be gladly welcomed, therefore the writer would propose that the material excavated from the canal should be used to fill in the channel between the north end of Blackwell's Island and the south end of the Astoria Island, as shown on the map, and thereby stop cross-currents at that point. This would be the cheapest and the most convenient place to dispose of the material excavated from the canal and the filled portion, added to the Astoria Island, would increase the size of Blackwell's Island by about forty acres.

If the city did not choose to use Astoria Island in that way, the writer would suggest that it might be used as a place on which the city or Government or private company could build a huge drydock, such as the city now, to our shame, does not possess; one able to dock the largest vessels that come to our harbor. Although, in some respects, not an ideal location for a drydock, still we would have there, what we have not at any of our present ones, a *good foundation* of rock, and, by placing an entrance gate at each end of the drydock, it would be unique and be rendered very convenient for vessels, either entering or leaving the dock, entering by one gate and leaving by the other. It would also be quite accessible to large vessels after the East River has been deepened to 35 feet and the velocity of the currents at Hell Gate reduced.

## A Black Finish for Iron

IT is frequently found desirable to give a black finish to the metal parts of harness and equipment. This is especially the case where armies wish to be as invisible as possible. A recipe which produces a solid black patina upon iron is given in a late number of *La Nature*, giving a handsome appearance and also preventing oxidation.

The pieces of metal are plunged into a bath, almost boiling, made by mixing 10 liters of water with 65 grammes of a liquid composed of the following constituents: Strong phosphoric acid, 57 cubic centimeters; water, 57 cubic centimeters; pulverized zinc, 18 grammes. The objects to be blackened must remain in the bath for at least half an hour or more, and sometimes for as much as three hours, to produce a durable coat.

## The Current Supplement

IN variety and value of its contents, the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT, No. 2053, for May 8th, 1915, will be most satisfying to every class of readers. It opens with the second of a series of lectures by Sir J. J. Thomson on Atoms and Ions, particularly as related to gases. This author's statements are authoritative, and the subject is one that must be most valuable to everyone interested in science. The Submarine in Naval Warfare is most timely, describing as it does the structural elements of this new engine of war and its tactical operation as developed in the present conflict. The Scientist and the Athlete describes the physiological laboratory of the French military school. There is a valuable article comparing the cost of operation, investment, and depreciation of gas, steam engines, and turbines as used in steel works and at blast furnaces. Italian military aeroplanes are described and the leading type is illustrated. There is a review of the work of Prof. J. C. Bose. Recognizing Vocations by the Teeth discusses a phase of vocational diseases that has received little attention. There is a valuable article on Copper Cyanide Plating Solutions. The paper on the Formation of Ozone in the Upper Atmosphere is concluded. An article on the super-dreadnought discusses the doings of the new English "Queen Elizabeth" at the Dardanelles. There are also articles on Indicating and Recording Time; Salt in Its Relation to Nutrition; High-speed Bullets and Dumdums; the Combustion of Coal in Boiler Furnaces and other topics.

## Industrial Accidents in Massachusetts

DATA gathered by the Massachusetts Industrial Accident Board show that in the year ending June 30th, 1914, there were 95,963 non-fatal and 608 fatal accidents reported to the commission; that the larger number of accidents occurred between 10 and 11 A. M. and 3 and 4 P. M.; and that all days except Saturdays and Sundays shared about equally in mishaps. No evidence appears that Monday morning offers a greater hazard to industrial workers than any other period of equal length. The wages of the largest group of workers suffering non-fatal accidents ranged from \$8 to \$15 per week, and the average wages of victims of fatal accidents showed the same group range. The maximum number of accidents occurred to workers earning from \$11 to \$12 per week; the wage-earners from 21 to 29 years of age met the largest number of non-fatal accidents, while the greatest number of fatalities were suffered by workers from 40 to 49 years of age. Of the whole number of non-fatal accidents, disability lasted less than one day in 40,661 cases. In 79 per cent of the cases the average duration of disability was two weeks or less. The average duration of disability was 12.48 days, approximately the same as in 1913. Taking the days lost as a basis, 3,992 persons were constantly disabled for a full-year. The wages loss for the year was \$3,172,440. Exclusive of insurance administration, the average cost of workmen's compensation per case was \$23.93. The number of accidents per thousand employees for twenty selected branches of industry was as follows:

| Industry. | Number per 1,000. |
|---|---|
| Automobile factories | 271 |
| Foundries and metal working | 257 |
| Slaughter and packing houses | 178 |
| Electrical supplies | 164 |
| Rubber factories | 153 |
| Box makers (wood) | 125 |
| Tanneries | 116 |
| Car and railroad shops | 99 |
| Box makers (paper) | 74 |
| Candy | 66 |
| Woolen and worsted mills | 65 |
| Cotton mills | 64 |
| Dyeing and finishing textiles | 56 |
| Carpet mills | 55 |
| Marble and stone cutters | 54 |
| Boots and shoes | 51 |
| Makers of blank books | 45 |
| Knitting mills | 43 |
| Jewelry factories | 39 |
| Clothing makers | 21 |

## To Old Readers of the Scientific American

THE June number of the SCIENTIFIC AMERICAN will commemorate the seventieth anniversary of the house of Munn & Co. In that number we wish to give a history of the SCIENTIFIC AMERICAN. Old readers and subscribers who visited the editorial offices in the past are requested to send us their impressions, anecdotes, experiences, and the like. Indeed, any information at all relating to the old offices on Park Row will be gratefully received by the Editors.

---

**Why Not Safeguard the Robes?**—If you have gone to a theater in an automobile you will have noticed the anxiety of the owner concerning his robes, especially as to whether they will be there when returning after the play. Is it not practicable to devise some means whereby any disturbance of the robes would cause an alarm, as the ringing of an electric bell or a turning on of the lights, so that the care-taker of a large number of automobiles would be notified instantly of interference?

# Correspondence

*[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]*

## Persistent Trail of a Meteor

To the Editor of the SCIENTIFIC AMERICAN:

At about 6:30 P. M. March 9th I witnessed at this town a very interesting meteorological phenomenon. While waiting for a train, I, with several other persons, was attracted by a falling meteor of exceptional brilliance descending in an almost vertical line, in a due westerly direction.

The extraordinary feature of this occurrence was the trail of white smoke or vapor it left in its wake. This vapor marked accurately the path of flight of the meteor and persisted in this position for some minutes.

To us observers, this vapor appeared to be not more than four or five miles away; however, on boarding the train we traveled at least four miles north before we seemed to be any farther north of the vapor than we were in Strang, proving that it must have been at a great distance from us.

The possibility of its being a bomb or anything of that nature is very remote. The falling of this body, notwithstanding its exceptional brilliance, is hardly remarkable, but the trail of gas, smoke or vapor, or whatever it was, is to me at least an extraordinary occurrence.

Strang, Neb. DR. J. C. HICKMAN.

[The visible trail left by a meteor, although usually of very brief duration, sometimes persists for several minutes, and even, in very exceptional cases, for an hour or more. These persistent trails are occasionally visible by daylight as well as at night.

A comprehensive account of such trails and an attempt to explain the conditions under which they occur was published in the *Popular Science Monthly* of August, 1911, by Prof. C. C. Trowbridge of Columbia University, and an abstract of this article appeared in the SCIENTIFIC AMERICAN of September 2nd, 1911, page 209. Prof. Trowbridge thinks that trails of long duration can occur only in a stratum of the atmosphere lying between forty-five and sixty-five miles above the earth's surface, and he calls this region the "meteor train zone." According to his hypothesis, the persistent trail is a phenomenon similar to the afterglow following an electric discharge in a vacuum tube and is possible only in a highly rarefied atmosphere.

Assuming the trail seen by Dr. Hickman to have been fifty miles above the earth, its distance from the point of observation may have been from one hundred to several hundred miles.—EDITOR.]

## Co-operative Boards of Health

To the Editor of the SCIENTIFIC AMERICAN:

Regarding your issue of April 10th, 1915, there occurred an editorial on "A Co-operative Health Board." The chairman of the Board of Health of Belmont, one of the towns included in this co-operative health plan, called my attention to the fact that in your editorial, as in an earlier editorial in the *World's Work*, the town of Belmont was omitted from the list.

A very complete record of the work of the organization up to April 1st, 1914, is given in reprint No. 222 of the United States Public Health Service, written by Prof. Phelps, formerly of the Massachusetts Institute of Technology, and now of the United States Public Health Service.

I am writing this letter with the idea that you might wish to refer inquiries to an authoritative report regarding the work of the Co-operative Health Organization. ROBERT N. HOYT,

Wellesley Hills, Mass. Agent.

## Right-hand vs. Left-hand Drive

To the Editor of the SCIENTIFIC AMERICAN:

I have noticed a couple of communications in the SCIENTIFIC AMERICAN regarding the tendency of drivers of left-hand driven automobiles to take to the middle of the road. I tour a good deal in a seven-passenger Franklin touring-car, right-hand driven. I usually sit in the front seat with the chauffeur, which brings me on the left side of the car, and gives me a splendid opportunity of observing how the cars we meet are run. My experience is that the left-hand driven cars all "hog" the road. I was out for a 30- or 40-mile drive yesterday, and this peculiarity on their part was particularly noticeable.

Southern California has hundreds of miles of splendid roads, either built by the various counties or by the State Highway Commission. Some of these roads, the first that were built, are but 16 feet wide, being built of rock macadam with asphalt surface. Others are 24 feet wide. The tendency of the left-hand driven car to get out of its place on the road and take to the center of the drive is especially noticeable upon these 16-foot drives. I was riding a few days since with a gentleman who was driving a left-hand driven car. I called his attention to the fact that he was in the middle of the road. He immediately pulled off to the side of the road, saying that he had not noticed it. Within five minutes he was back in the middle of the road.

Now, there must be something in the position of the driver that causes this conduct. It cannot be that all the drivers of left-hand driven cars have simply become lawless. I think that they are unconscious of doing it. Before the days of automobiles, I always kept a good team and drove a great deal myself, and I never felt comfortable sitting on the left-hand side of a vehicle; in fact, I was almost helpless. It may be possible that those who have driven right-hand driven cars have something of the same feeling. I defy anyone to take a drive any Sunday or holiday in this county, when there are thousands of cars going and coming, without being impressed with the facts that I have stated above.

Los Angeles, Cal. J. A. GRAVES.

## An Early Use of Khaki

To the Editor of the SCIENTIFIC AMERICAN:

In your correspondence column of April 3rd the question is raised as to when the khaki dye was first used for soldiers' uniforms and the writer dates it back to 1877. Now, I wore khaki-colored uniform in 1858 during the Indian mutiny war, being then in the East India Company's army. The uniform worn by us at that time had been white drill, but it was found to be unfit for the rough work of the campaign; it showed the dirt too much. So orders were given to have it dyed a brown color called khaki, used by the natives. This was at Ahmednuggur, Bombay Presidency. The dye was very inferior, did not stand washing well, but it served not only the original purpose, but also that of making our soldiers less conspicuous to the enemy.

JOHN P. DUNLOP.

## The Donation of Patents to the Public

To the Editor of the SCIENTIFIC AMERICAN:

The important inventions of Dr. Walter F. Rittman relating to the production of gasoline and certain bases for high explosives and his dedication of the United States patents to the public have attracted much attention and aroused the admiration of all for the inventor's patriotism. There is some question, however, whether the dedication of this patent will operate to the benefit of the public to the same extent as if the patent had been privately operated with a reasonable regard for the public. Is it probable that the telephone would have the universal use and the practically unlimited range it now offers the people if it had not in the first instance enjoyed the fostering influence of our beneficent patent system?

Senator Orville H. Platt of Connecticut, in addressing the U. S. Senate in 1884, touched upon this very point in referring to the inventor as "a laborer entitled to his hire, entitled to it more, if possible, than any other laborer, as his labor is higher in dignity and grandeur than that of any other laborer." He quotes the testimony of Sir Henry Bessemer of steel fame as found on page 103 of a work called "Creator of the Age of Steel," a part of which is as follows: Sir Henry says, "I do not know a single instance of an invention having been published and given freely to the world and being taken up by any manufacturers at all. I have myself proposed to manufacturers many things which I was convinced were of use but did not feel disposed to manufacture or even to patent. I do not know of one instance in which my suggestions have been tried; but had I patented and spent a sum on a certain invention . . . I should have found someone who would have taken it upon the offer of some advantage from me and who would have seen his capital recouped by the fact that no other manufacturer could have it quite upon the same terms for the next year or two. . . . I believe inventions which are at first free gifts are apt to come to nothing."

Do not the views of this distinguished man give us food for thought in this day? The writer thinks that the views of Edison, Marconi, the originators of the commercial moving-picture machines, and other leading inventors might bring the public to believe that the reasonable control of an invention afforded by the patent laws is a benefit to the people at large as well as to the inventor. A CONSTANT READER.

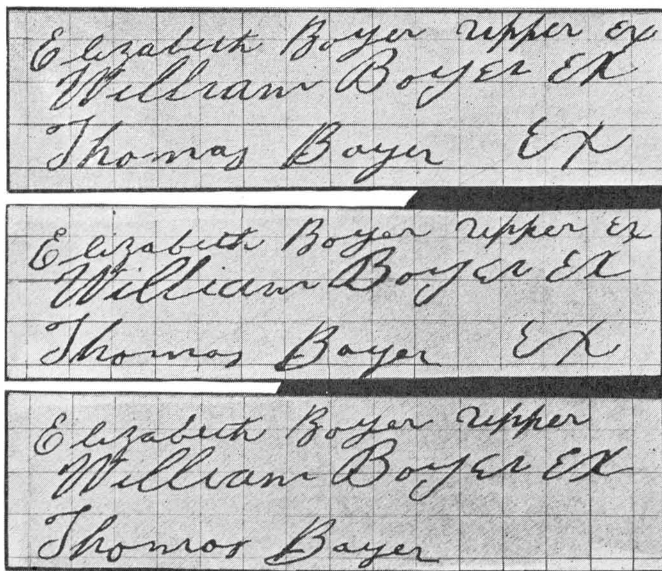
## Fly Trap Wanted.

To the Editor of the SCIENTIFIC AMERICAN:

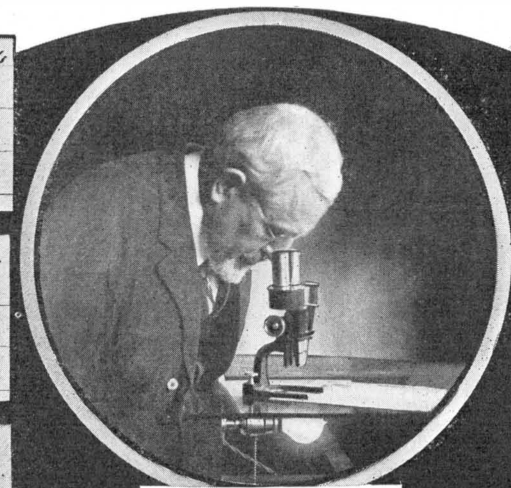
In your issue of October 10th last (page 240) there was given a description of a fly trap recommended by the Department of Agriculture, which, after trial, we find most ineffective. The best fly trap we have found up to date is the ordinary glass dome trap, but we should be glad to try any form of trap which can be made here, which any of your readers may be able to recommend. F. E. MULCAHY.

Explosives Factory, Hiratsuka, Japan.

Traced forgeries, photographed under ruled squares.

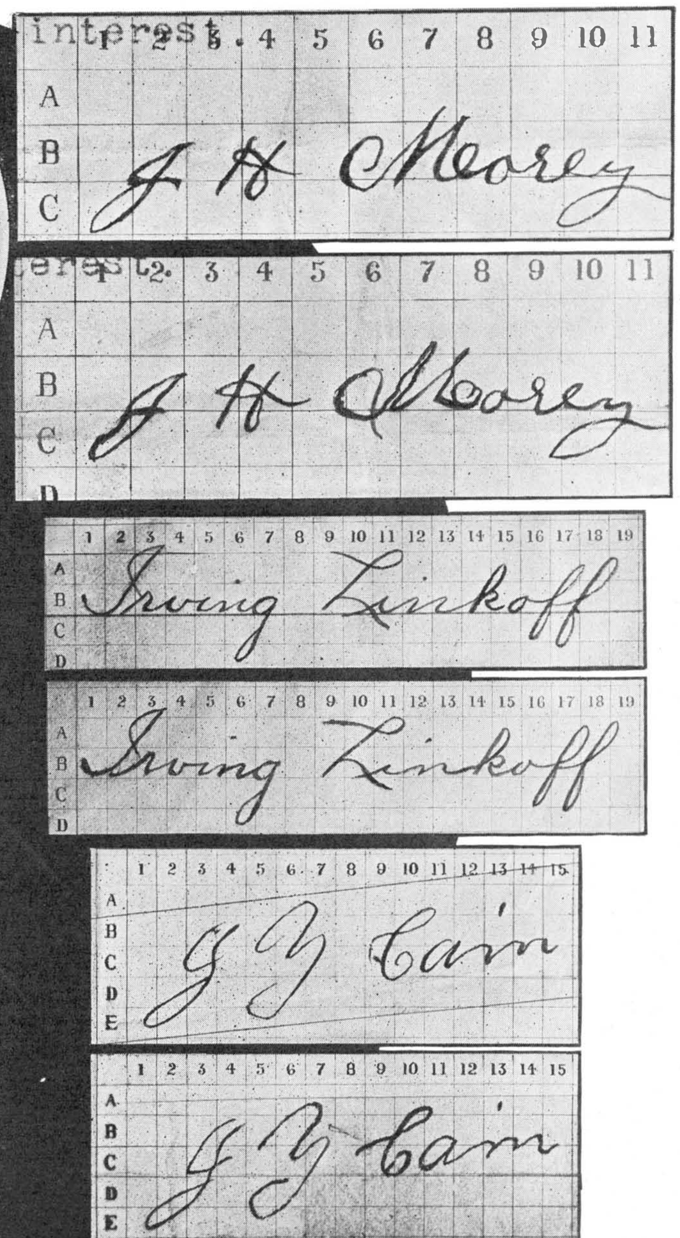


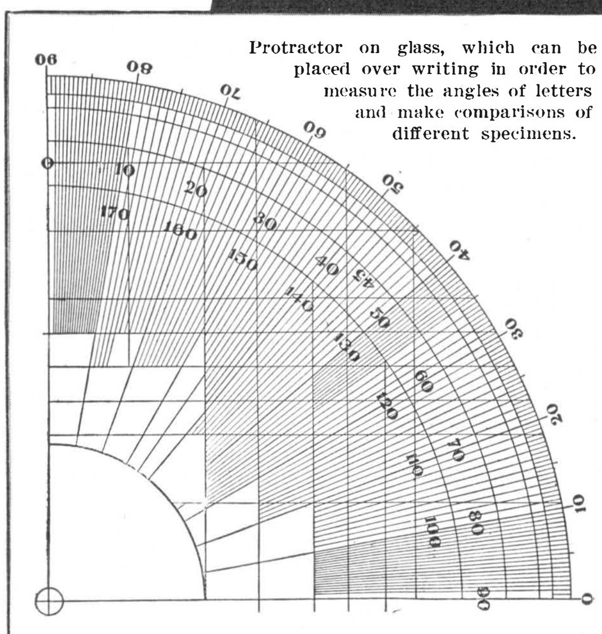
Stereoscopic microscope on glass table with light beneath.



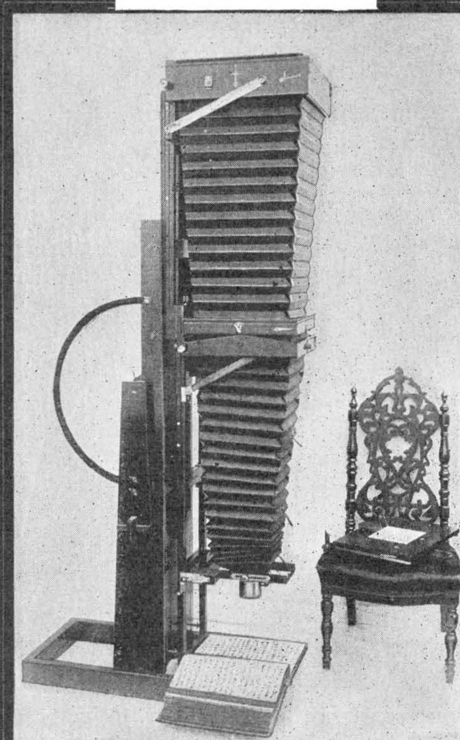
Albert S. Osborn

Traced forgeries, showing damaging identities.



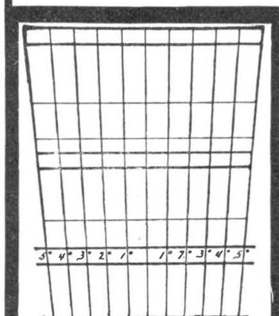


Protractor on glass, which can be placed over writing in order to measure the angles of letters and make comparisons of different specimens.

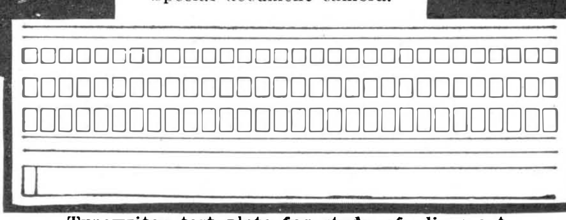


Special document camera.

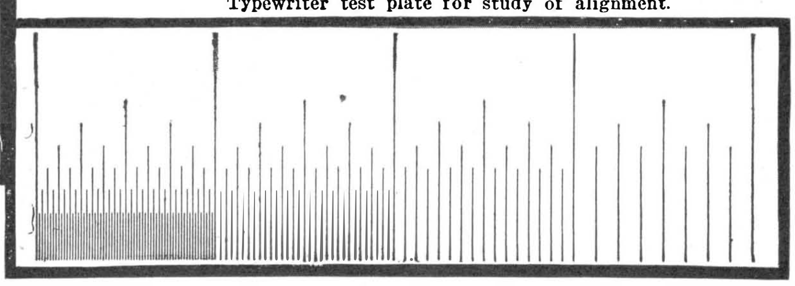
Typewriter line measure, from one 64th, increasing by 256ths of an inch.



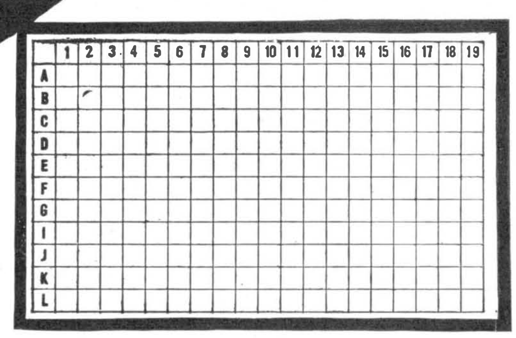
Typewriter protractor ruled on glass for comparing letter angles.



Typewriter test plate for study of alignment.



Four-inch measure on glass, 8ths to 64ths of an inch.



Glass plate ruled in squares, all exactly the same size. By means of this gage, which is placed over a specimen of writing to be examined, every detail of a letter or word can be analyzed and accurate comparisons made, showing identities or differences; a result which could not be obtained in the older methods.

# Science and the Forger

## Instruments and Illustrations in Questioned Document Cases

By Albert S. Osborn, Author of "Questioned Documents"

THE giving of definite reasons for an opinion and the use of illustrations and instruments in proving the facts in a court of law in a questioned document case is a proceeding so comparatively new that it is always objected to, and now and then not permitted. The old idea of evidence in these matters was that it should be received through the ears, and a case was "heard" and not "seen," and the modern method of interpreting and illustrating testimony and thus showing the facts in visible form has met with vigorous opposition.

Not until recently was any standard writing admitted in evidence for comparison, nor was any juryman permitted to look at a photograph or at evidence through a microscope. but was simply told what others saw, or knew, or thought, and there still are courts where jurymen are not permitted to see for themselves. Some of the old objections were no doubt originally based upon the then reasonable presumption that the juryman could not read and write, and was therefore more likely to be deceived and misled by his own eyes in a document investigation than by the oral testimony of others, but the same rules made it impossible to show anything to an intelligent referee or an able and experienced judge. In the ancient practice, therefore, the one called upon to decide the case was supposed to listen to what others said regarding a disputed document and then try to determine, often from conflicting stories, who probably was telling the truth.

The old method is slowly passing away in all cases where evidence can be made visible, and judge, referee, and jury are asked to look for themselves at the physical facts with all kinds of microscopes and magnifying glasses, and these facts are interpreted and made plain by special enlarged photographs and grouped illustrations. By these methods the observer, by the use of two senses, certainly is better able finally to understand what the fact is and determine who is telling the truth. The modern practice that makes evidence appeal to two senses instead of only one is now becoming generally recognized as entirely reasonable and desirable. In this manner has arisen the necessity for instruments and illustrations in disputed document cases.

As was inevitable, these modern methods of presenting evidence have had a marked effect on the administration of justice, and by their use a verdict is based not upon the amount of the evidence, but upon its quality, and some of the discredit brought upon expert testimony by vague and intangible evidence of the doctors and the alienists is being removed. One competent witness on the side of the facts can prevail against a room full of witnesses against the facts. In a recent important case six alleged eye-witnesses testified that they saw a certain document signed and twelve jurymen, to whom the facts had been shown, declared it to be a forgery.

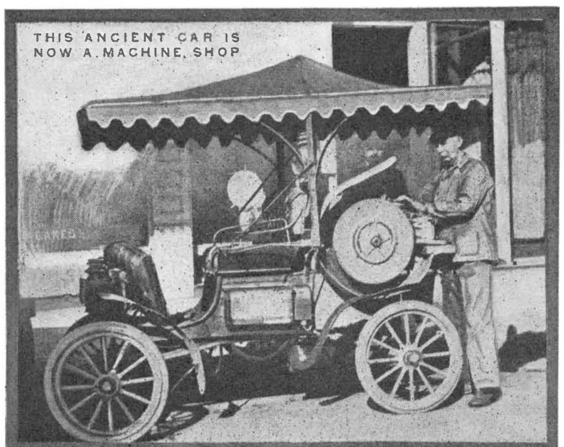
The completely equipped examiner of questioned documents in these days needs certain instruments for his business as much as the surveyor does for his. The photographic camera, the microscope, and the necessary instruments for making accurate tests, measurements,

and illustrations are the charts and compasses of the business, and they, with the aid of the witness, really present the testimony. In all disputed document cases there are two requirements: first the discovery of the fact and then the proof of it in court. The qualified expert may not need to use instruments or to make illustrations in order that he himself may discover the fact, but instruments and illustrations often are absolutely necessary in order that the inexperienced and untrained who may be called upon to decide the question may be led to see clearly and appreciate fully the significance of the visible physical facts.

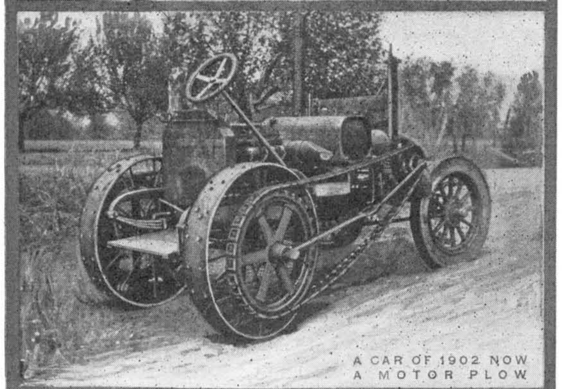
The whole of modern procedure in relation to proof of documents is thus being revolutionized by this method of making concrete and visible the main testimony in such cases. This method also in large measure takes document testimony out of the class of mere expert opinion testimony, with its inevitable conflicts, and puts it into the class of demonstrative testimony which in many cases can be readily seen, properly appreciated, and fully understood by an intelligent juryman.

Without the aid of the photographic camera a handwriting or document case can hardly be properly presented in a court of law. Seeing ability varies greatly with different individuals, and even a slight enlargement makes more distinct and may actually make visible to certain observers what otherwise cannot be seen. A suitable enlargement often presents a matter so much more clearly that the evidence at once carries conviction. Photographs also permit a side-by-side comparison by making it possible to put things close together, which is the only way certain things can be effectively compared, because of the inability of the eye to carry an image for even a brief time or over a short distance. With most observers, therefore, visible things to be compared must be looked at at the same time. Photographs make such comparisons possible by permitting the dissection of accurate reproductions of documents and the grouping of similar or dissimilar parts.

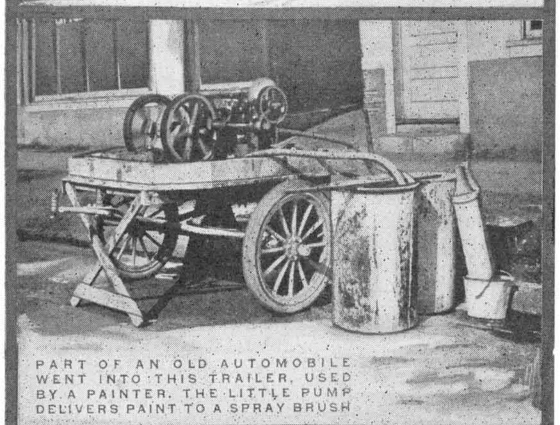
The psychology of habit underlies much of the scientific study of the subject of disputed handwriting, and the principles of psychology have a most important bearing on many phases of the study of the subject of forgery. Given the same conditions, minds work in much the same way whatever they are attempting to do. One of the greatest obstacles to success in forgery is overanxiety to do it well, and this effort shows itself in the tangible result. The forger locks the door, pulls down the curtains and tries to do the task so well that he overdoes it. Furthermore, he usually is not satisfied with the result as it first appears and often carefully repairs it, adds to, overwrites, and perfects his first attempt. Such careful corrections or additions, always inconsistent with genuineness, may not change the color of the ink, and if skillfully done may not be seen under ordinary view, but when examined or photographed by strong transmitted light, especially under magnification, the telltale varying thicknesses of the ink film are instantly disclosed, enabling the observer literally "to see through" the forgery.



THIS ANCIENT CAR IS NOW A MACHINE SHOP



A CAR OF 1902 NOW A MOTOR PLOW



PART OF AN OLD AUTOMOBILE WENT INTO THIS TRAILER, USED BY A PAINTER. THE LITTLE PUMP DELIVERS PAINT TO A SPRAY BRUSH


A SECOND-HAND CAR FITTED WITH ADVERTISING BODY

Most forgeries are produced either by a tracing process or by a simulating process. In tracing, the operator seeks to reproduce line for line and dot for dot a genuine signature with the natural thought that if he can make one just like a genuine one, no one can detect it, and then, in addition, he is often so shortsighted as to put this very model signature in evidence in the effort to prove his imitation to be good, because it is "just like" a genuine signature. It does not occur to him until he is arrested or he presents his forgery in court that genuine signatures are not just alike and that it is a very damaging circumstance when a disputed signature is exactly like a certain genuine signature which may have been used as a model, and what he thought of as evidence of genuineness naturally becomes evidence of forgery. This identity is especially damaging when the disputed signature in its line quality and retouching shows that it was not really written but slowly and carefully drawn. In such a case it is desirable to illustrate this damaging similarity, which is done by photographing the disputed signature and its model under ruled squares so that merely by inspection the damaging similarity can be seen.

In certain cases means for making and illustrating accurate measurements are essential if the facts are to be proved. In a typewriting case the falsity of a document can sometimes be shown by simply showing that certain letters are narrower or wider than other letters. It is necessary in such cases that measuring instruments be provided that enable an ordinary examiner to see and appreciate the physical facts.

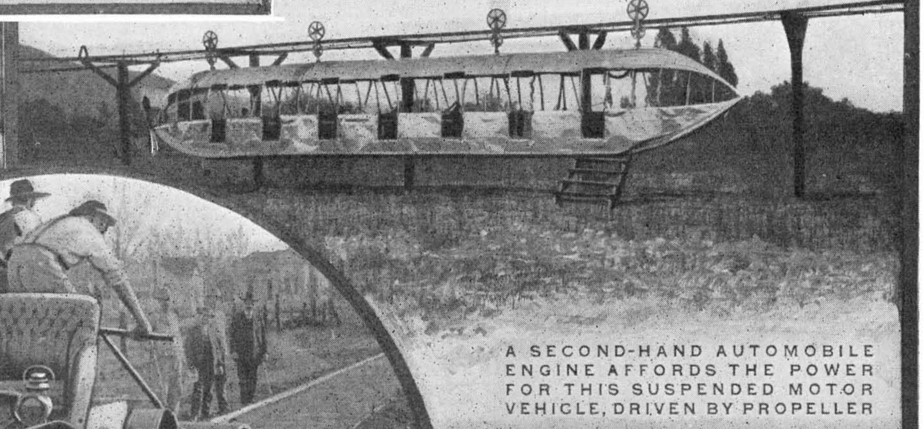
## What Becomes of the Second-hand Automobile?

THE accompanying photographs answer in part the question that everyone has asked at one time or another, "What becomes of the second-hand auto?" With so many thousands of new cars constantly coming on the market, it seems as if there would be a tremendous oversupply of used cars of antiquated model that would be impossible to sell for pleasure vehicles, and that would have to go to the junk pile. The ingenious manner in which small tradesmen, ranchers, advertisers, and mechanics in various lines of industry have solved this problem is vividly shown in the series of pictures of re-built machines, many of which are adapted to uses that their manufacturers never dreamed of.

A cement contractor has fitted up a trailer composed almost entirely of the parts of outworn autos, which makes a very effective concrete mixer, and which is towed by his little runabout, also a second-hand machine. A knife grinder has set up a complete shop for

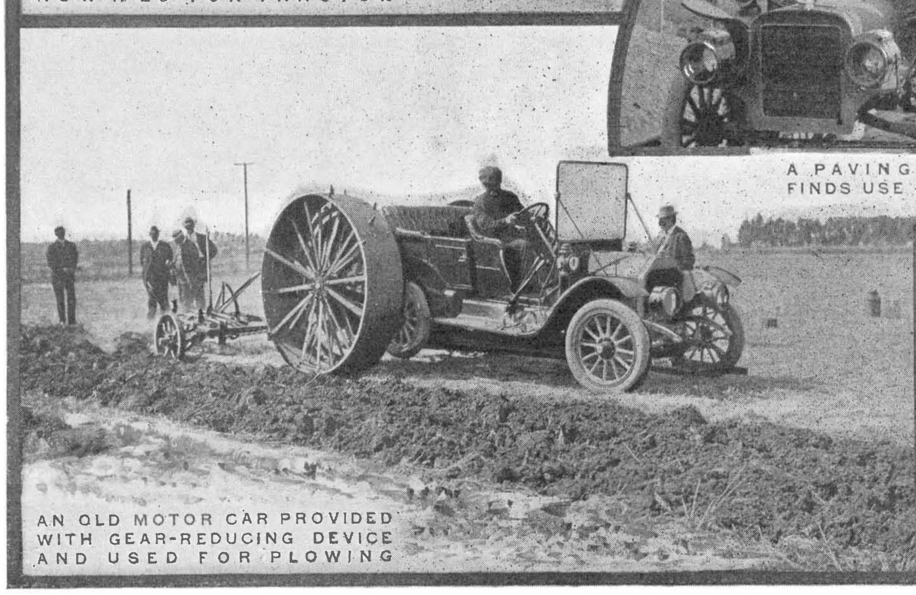
(Concluded on page 440.)

A 60-HORSE-POWER USED CAR NOW A 20-TON TRACTOR

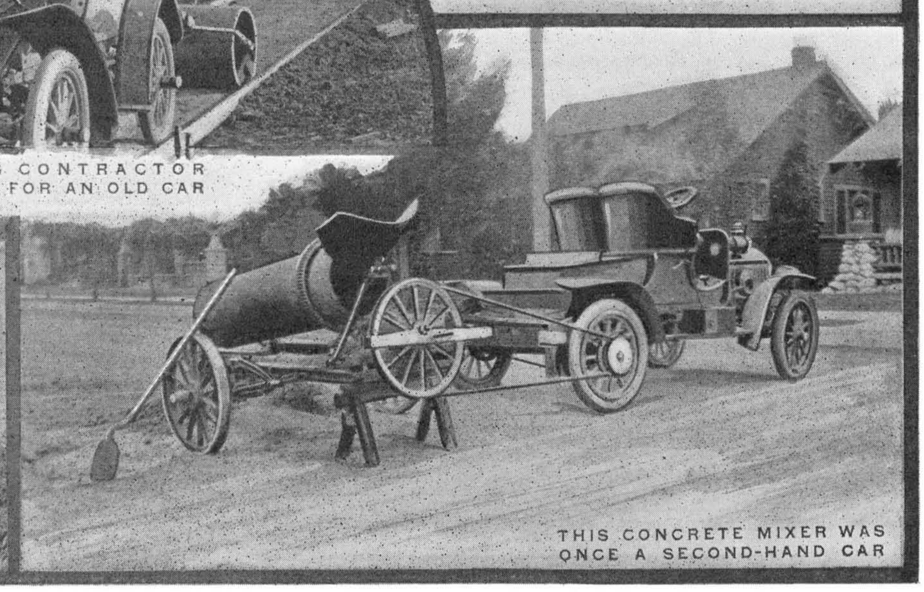


A SECOND-HAND AUTOMOBILE ENGINE AFFORDS THE POWER FOR THIS SUSPENDED MOTOR VEHICLE, DRIVEN BY PROPELLER

A PAVING CONTRACTOR FINDS USE FOR AN OLD CAR



AN OLD MOTOR CAR PROVIDED WITH GEAR-REDUCING DEVICE AND USED FOR PLOWING



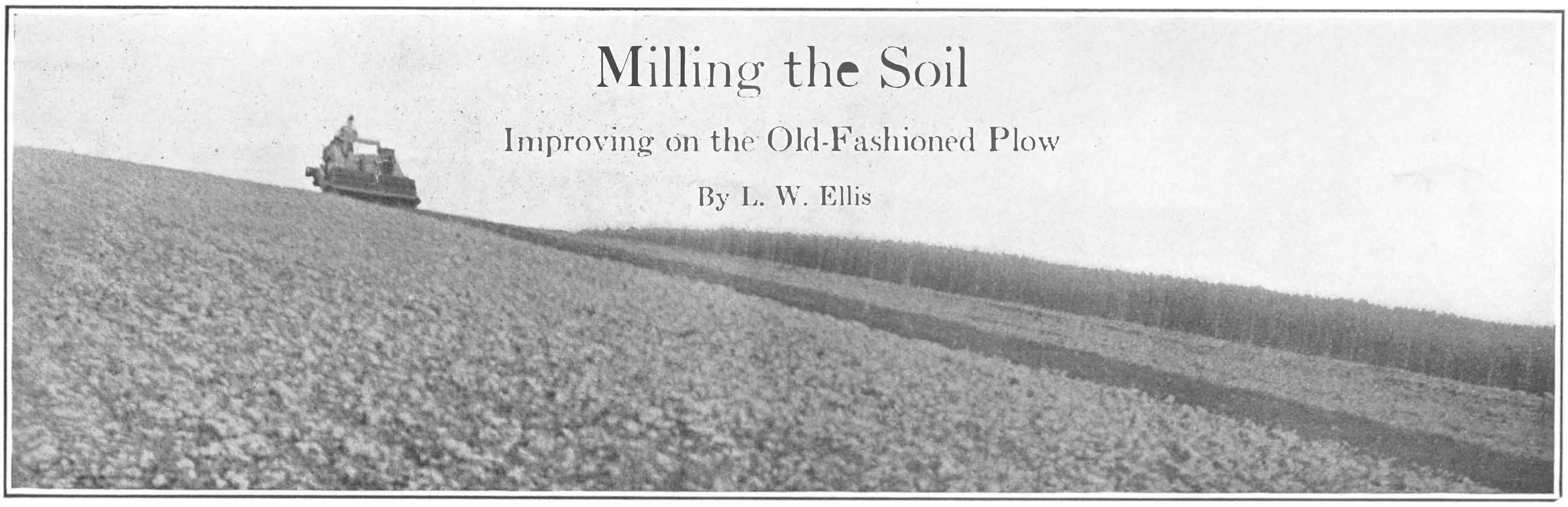
THIS CONCRETE MIXER WAS ONCE A SECOND-HAND CAR

**A series of re-built machines that have solved the problem of the use of second-hand automobiles.**

# Milling the Soil

## Improving on the Old-Fashioned Plow

By L. W. Ellis



**Deep cultivation on fallow land by a Meyenburg soil miller.**

THE Greeks gave Ceres credit for inspiring one Triptolemus to invent the plow. Later students have suggested that the supposed divine origin of the implement had something to do with barring sacrilegious improvements upon it until a little over a century ago, when Thomas Jefferson reduced it to mathematical principles and the first real plow manufacturing began. Certain it is that anything so radical as a proposal to abolish the plow altogether would be regarded by the average farmer as unthinkable were it not for the fact that at least two types of rotary auto-cultivator had reached the practical marketing stage in Europe previous to the war, one of them being manufactured in this country also. This type of machine, variously known as a rotary cultivator, soil milling machine, motor hoe, etc., pulverizes the soil thoroughly at one operation to the full depth of the cut, no disks or other harrows being needed for preparing a seedbed of ideal physical conditions.

Since Jethro Tull first outlined the modern principles of tillage, the aim of implement designers has been to break up the furrow slice into the granules which afford greater root pasturage, hold abundant moisture, and provide for proper soil aeration. The indictment of the plow is that it is a makeshift, merely a combination of wedges for making the best possible use of the one power always available hitherto, i. e., the linear pull of a draft animal. Only rarely does it effect a complete pulverization, and in the hand of a careless farmer the plowsole may easily form a so-called "share hardpan" and work considerable damage to the land.

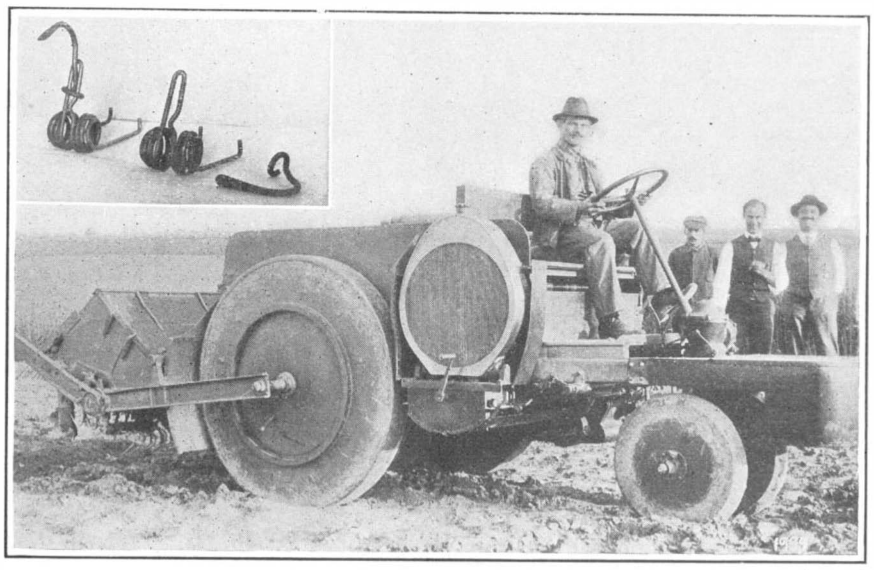
The crop return due to the better preparation of the soil has long been recognized, and Kropotkin's colony of exiles in England is said to have shown a profit even after putting soil through a grinding machine and restoring it to its place.

So long ago as about 1850, an English farmer, Hoskyns by name, recorded his theory of a motor cultivator embodying a rotary working tool equipped with mole-like claws for scratching the earth. He condemned the plow and the implements that follow it, and insisted that the proper application of mechanical power to the soil was in a rotary direction, citing the successful rotary action of the paddle-wheel, the circular saw, the threshing cylinder and other devices working directly upon material to be moved or changed in form.

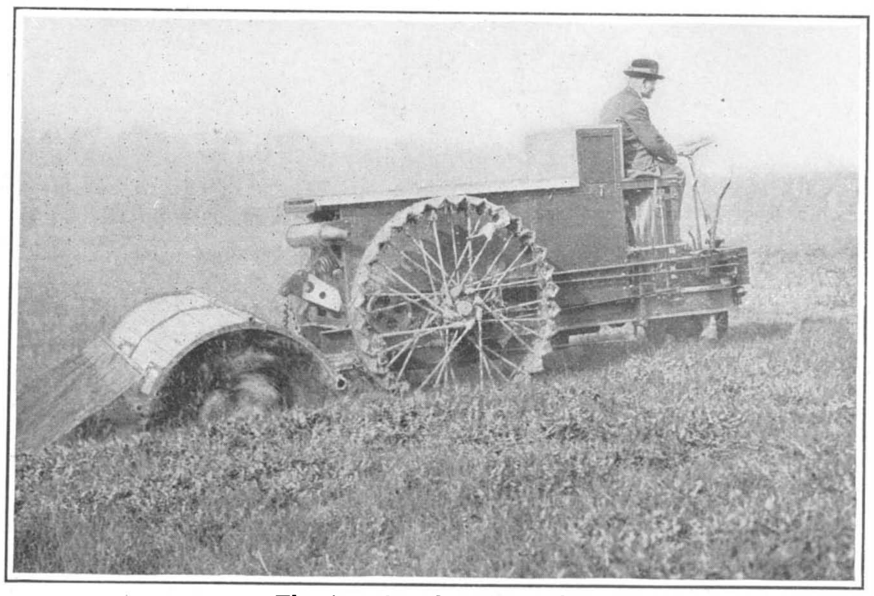
Hoskyns's idea of a rotary tool has since been applied to many experimental machines in this country. A South Dakota college professor advanced the idea of a soil auger. A Kansas farmer fitted a drum with a large number of miniature plows. A Colorado man built an earth saw, and a California inventor brought forth a spading wheel. A Nebraska company propelled a tractor by an immense cylinder studded with hooks which were supposed to tear up the ground at the same time. European inventors duplicated all these ideas and more, but all failed, commercially.

The one principle which has endured is that of a vehicle carrying at the rear a horizontal cylinder of some sort, actuated independently of the vehicle, and equipped with comparatively small cutting tools. Of the two types of cylinder employed—one rigid, the other flexible—the latter unquestionably does the superior work, bearing out Hoskyns's prediction of 1850.

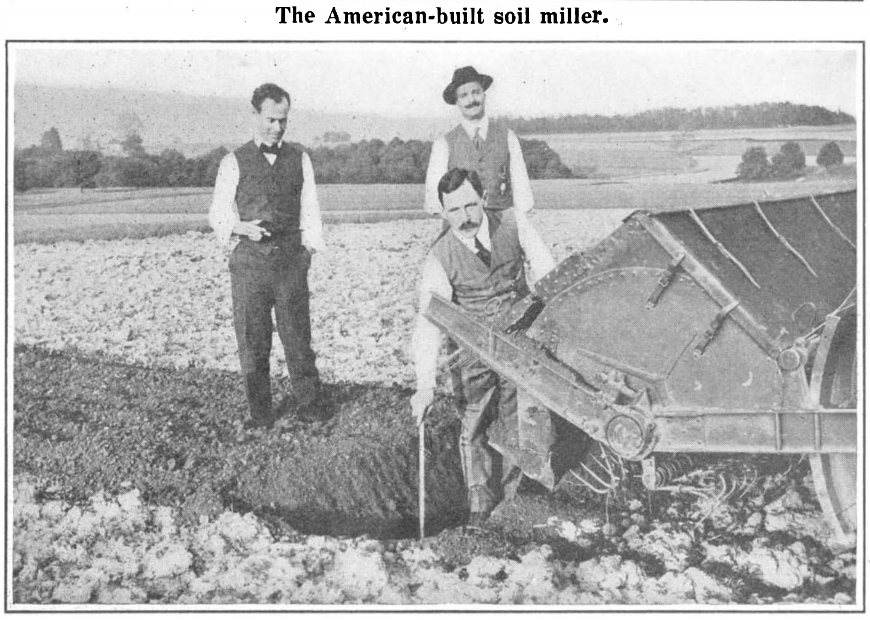
The advantage of the rigid type is a probably lower repair bill except in stony ground, a concession to which is made in one case by wooden break-pins, acting as a safety feature. The flexible tool, on the other hand, takes a smaller "bite," scratching, rather than cutting, and producing much finer granules.



**The Meyenburg soil miller.**



**The American-built soil miller.**



**Milling claws and soil bed prepared by the Meyenburg machine.**

One machine of the flexible type made in the United States is of Swiss invention, after researches instituted about 1901 by one St. Georgen, in Zurich, and carried to a successful issue by Konrad von Meyenburg of Basel. The vehicle itself is not important; in fact, in the earlier experiments the tool was mounted upon a wagon drawn by a block-and-tackle. The essentials at present seem to be lightness; a short wheel base; independent control of drive wheels so one may be stopped and a very short turn made; a separate drive for rotating the cylinder; means for raising and lowering the cylinder; and, of course, a motor. It is interesting to note that after an exhaustive survey of the world's light motor field, the Swiss inventors chose for their experimental work a two-cycle marine motor made in the United States.

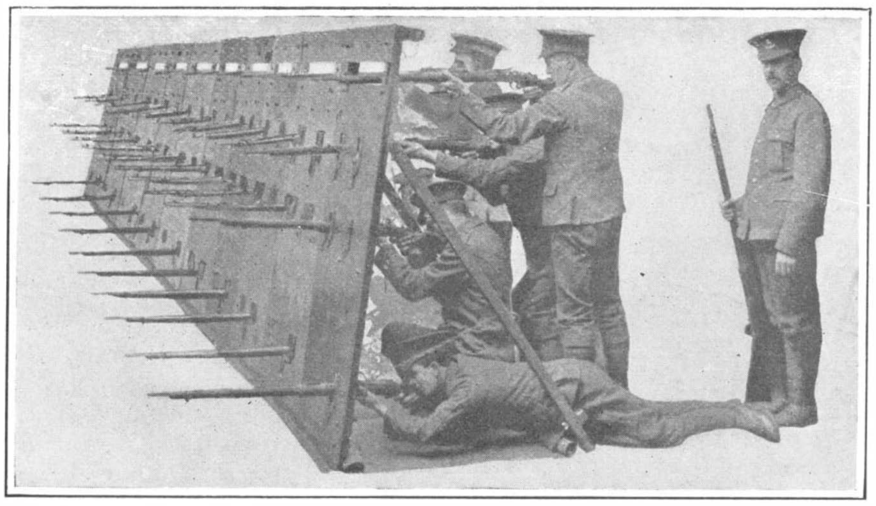
The rotor, or cylinder, runs in the same direction as the travel of the machine and actually helps to propel it. The outfit can thus be made very light—4,500 pounds for a two-meter width and 1,400 pounds for the one-meter. Three or four speeds are provided, since the condition of the soil and depth of cut will naturally affect the rate of travel. A motor of 30 horse-power furnishes power to till from four to ten acres in ten hours, at depths of about 12 to 3 inches, respectively, a very creditable showing, considering the amount of material subdivided.

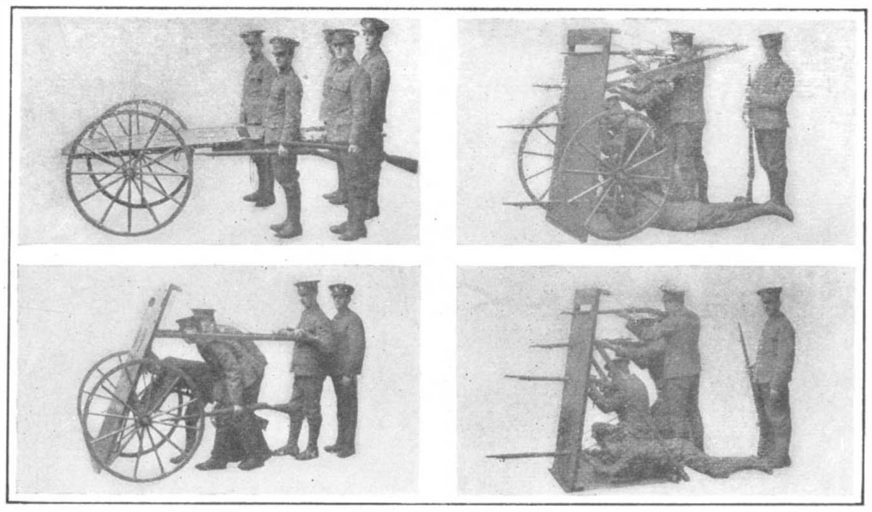
The cylinder is, of course, the vital feature. Flexible steel claws, held by steel spring holders, are ranged about a horizontal axis, and the whole rotated at about 150 revolutions per minute. Use in stony, hard, wet, and trashy ground has apparently brought out no limiting factor so far as quality of work is concerned, though the best of material is required in the hooks and holders to postpone crystallization.

Briefly, the advantages of such a tillage tool, outside of the use of mechanical power, are the preparation of a more favorable seed bed; immediate mulching of the soil and its increased water-holding capacity; uniform distribution of manure; saving of seed; greater yield. In addition the vehicle can be applied to some of the uses of an ordinary tractor. The mechanical perfection of the machine and its adoption by the average farmer will no doubt be slow. The fact that it is already a commercial product is, however, significant in view of what may very likely prove to be a profound revolution in methods of handling the soil.

---

**A Simple Poison Indicator.**—To indicate that a bottle contains poison a patent, No. 1,131,839, to Mahalah T. Hudson of Kirksville, Mo., shows a frame carrying a bell which will ring when the bottle is moved, the frame having a plate with depending spurs which can be forced into the top of a cork in order to anchor the frame upon the cork of the poison bottle.





Courtesy of London Illustrated News

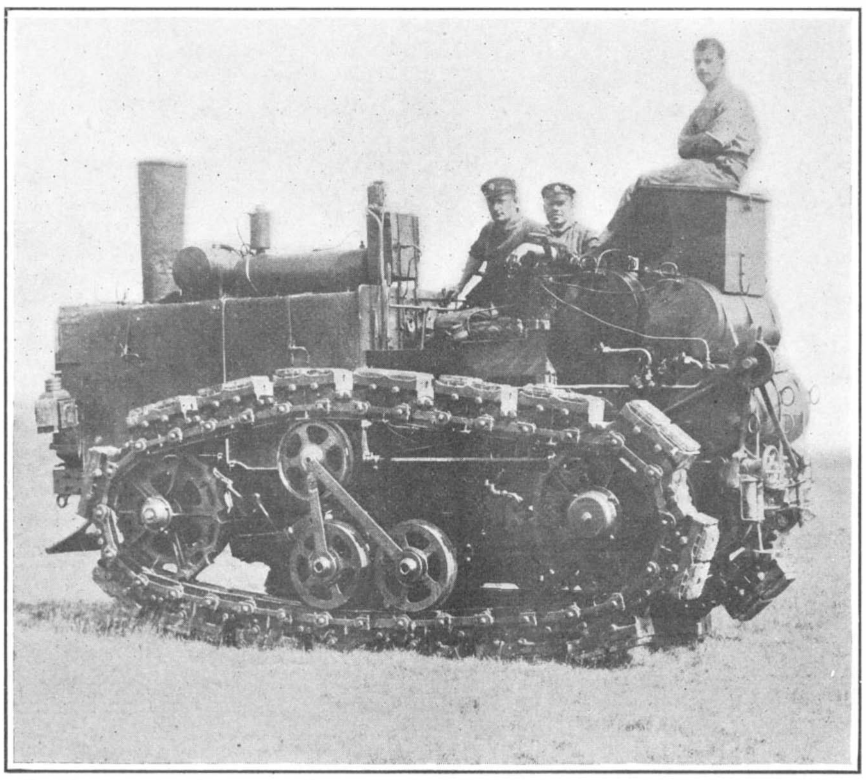
**Bullet-proof shield on wheels for attack or defense.**

An armored shield behind which men may advance or may barricade a road, or the like, was submitted recently to the British War Office. The small pictures show various uses of the device. It may be transported like a two-wheeled cart, carrying on the shield plate a supply of ammunition. It may be used as a temporary barricade or as an advancing or retiring shield, or the wheels and springs may be removed to form a fixed barricade. Ten such shields placed side by side form a 30-foot barricade.

Photo by Paul Thompson

**A pocket periscope.**

The British army has just adopted an angle mirror periscope which may be attached to a bayonet point to give a view over the rim of a trench.



Copyright American Press Association

**British caterpillar tractor.**

The warring nations have found the caterpillar and ped-rail type of tractor indispensable for hauling artillery and equipment over uneven ground. This picture shows a machine used by the British army. Intermediate of the main sprocket wheels are idlers adapted to take up slack and provide better traction.

Courtesy of London Illustrated News

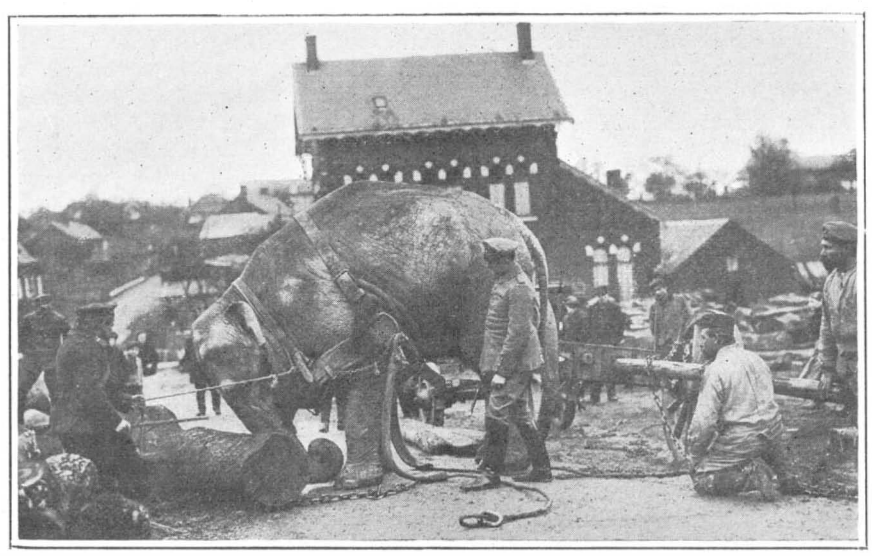
**A 42-centimeter shell.**

This unexploded 42-centimeter shell fell in soft ground near Verdun. Height, 1½ m.; weight, 2,108 lbs. A French 75 mm. on left, and German 77 mm. on right.

Photo by Paul Thompson

**Protection against poisonous fumes.**

The poisonous fumes that are given off by the explosion of modern high-power shells make it necessary for the men in the trenches to wear special or improvised respirators.



Copyright Brown & Dawson

**Elephant as a war horse.**

We would not be surprised to find elephants doing service in the Indian contingent of the British forces, but apparently even the German army makes occasional use of them.

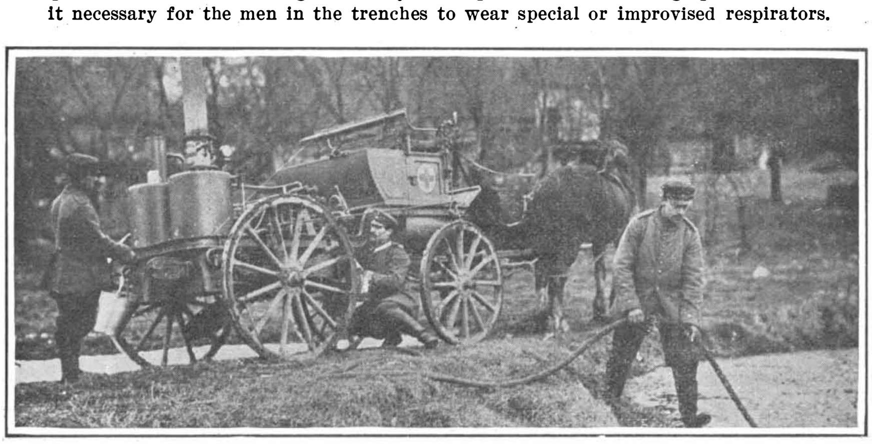


Photo by Paul Thompson

**Traveling boiler of the German Red Cross Division.**

It supplies filtered sterile water for washing wounds.

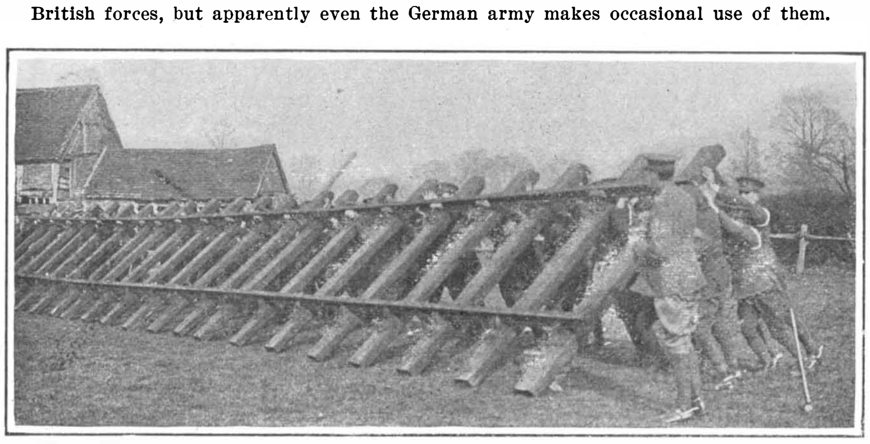
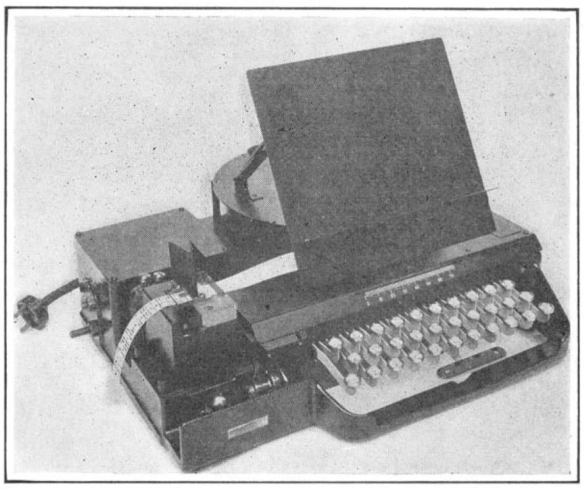


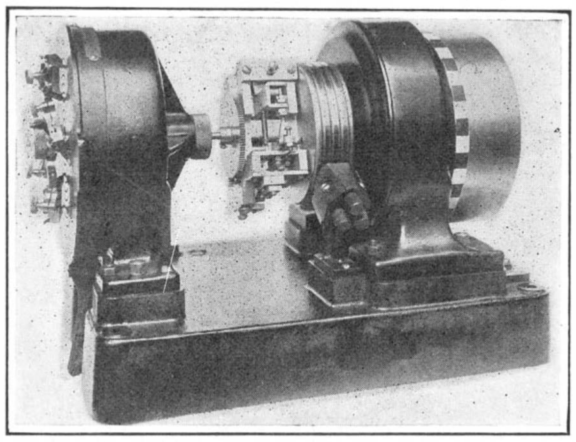
Photo by Paul Thompson.

**Railway construction drill.**

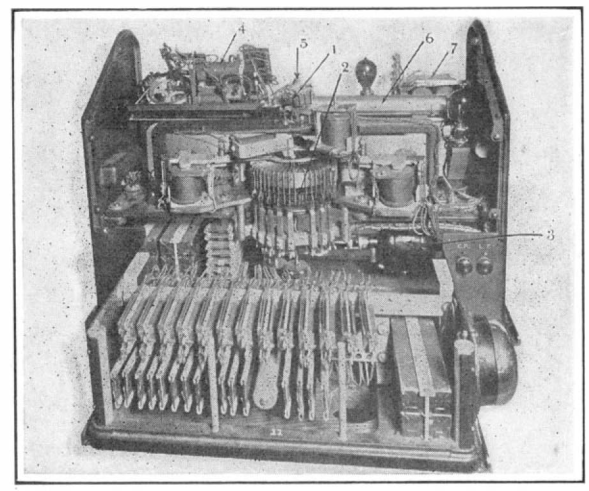
British recruits learning how to build a light railway.



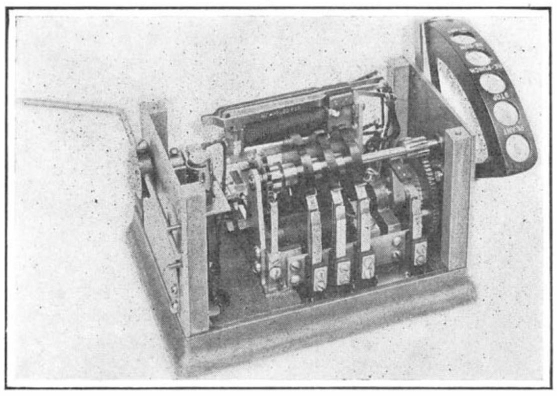
The tape perforator.



The motor and the distributor.



Interior of the printer and relay, which is operated by the transmitter of the distant station and prints the message on a telegraph blank.



Interior of the automatic controller.

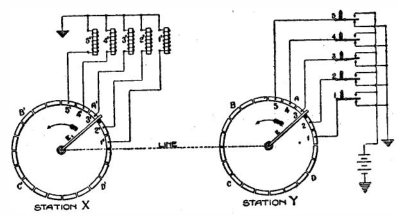
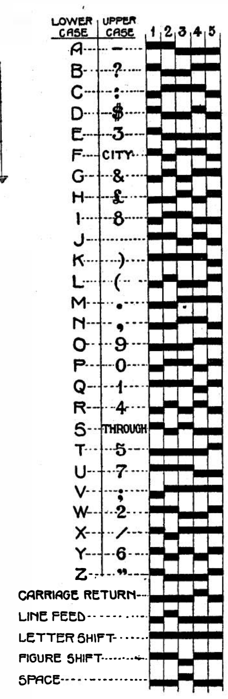
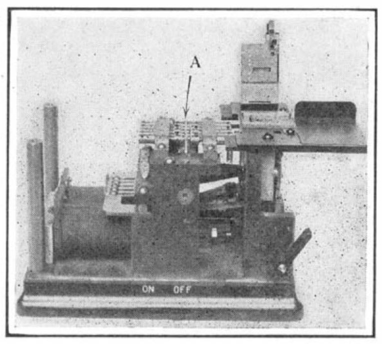



Fig. 1.—Subdivision of the quadrants.




Interior of the transmitter.

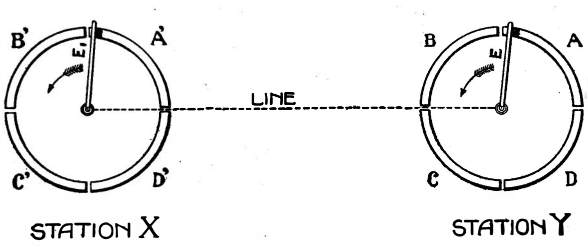



Fig. 2.—The Baudot multiplex transmission.

Fig. 3.—Baudot code.

Transmitting and receiving apparatus.

**Some of the apparatus used in the new multiplex page-printing telegraph.**

# A System of Long Distance Typewriting

## Eight Messages Sent Simultaneously Over a Single Wire

For over a year the Western Union Telegraph Company has been putting to a rigorous test in actual commercial service what is virtually a system of long-distance typewriting. In other words, the operator at the transmitting station uses a keyboard similar to that of a typewriter, but the typing is done at the distant receiving station, and there directly on a telegraph blank, so that no time is lost in transcribing the message, as is usually necessary.

Broadly, it is a combination of two existing systems, namely, the multiplex system of Baudot and the page printer of Murray. Of course, the combining of these two systems has involved a great deal of invention and has resulted in the development of many improvements, credit for which belongs to the engineers of the Western Electric Company, who designed and built the apparatus, and the engineers of the Western Union Telegraph Company who co-operated with them.

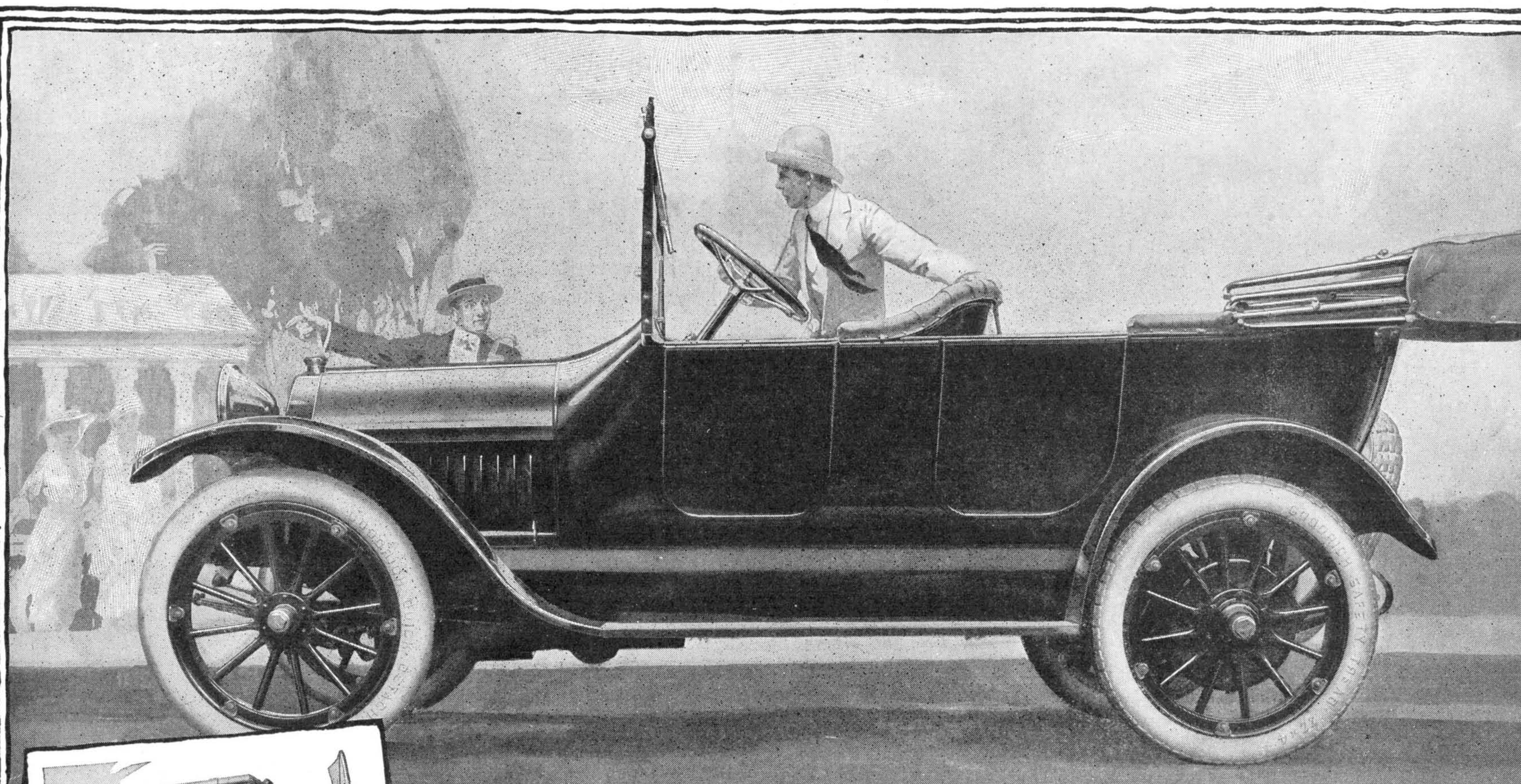
Each key of the transmitting keyboard sends its own characteristic signal or set of electrical impulses over the line, which actuate the printing mechanism at the far end and cause it to impress the corresponding character on the paper. However, the signals used belong to the Baudot code rather than the Morse alphabet. This is illustrated in Fig. 3, and it will be observed that every letter is made up of five units, consisting of positive and negative impulses, instead of dots and dashes. Those above the line in the illustration represent positive units and those below negative. Thus, the letter "A" consists of 1 and 2, positive, with 3, 4 and 5, negative, while "B" consists of 1 positive, 2 and 3, negative, and 4 and 5, positive. The code is shortened by the use of an upper case controlled by a special key as in a typewriter, which provides for punctuation and numerals, as well as certain abbreviations.

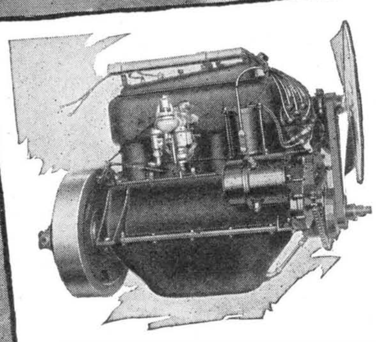
We have referred to this system as one of long-distance typewriting, and this is particularly true of one form of apparatus known as the "short line printer," in which, when the operator depresses a key, the printer at the receiving station immediately impresses the corresponding letter on the telegraph blank. But the transmitting and printing mechanisms are capable of far higher speed than is a human operator, and for this reason the Baudot system of sending signals from four different operators in rapid succession has been adopted. This principle is illustrated in Figs. 1 and 2. In Fig. 2, for instance, two contact rings are shown, one at the sending station *Y*, the other at the receiving station *X*. These are divided into the quadrants *A*, *B*, *C* and *D*, and *A'*, *B'*, *C'* and *D'*, respectively. Sweeping over the quadrants are the contact arms *E* and $E^1$, respectively, which are connected by a telegraph line and which are arranged to revolve at a uniform rate, so that quadrant *A* is electrically connected with the quadrant *A'*, quadrant *B* with *B'*, etc., once at each revolution. Now consider the quadrants subdivided into five segments, as indicated at *A* and *A'*, in Fig. 1. Each segment of quadrant *A* is connected to a lever which may engage one of two contact points. One point is grounded and the other is connected to a grounded battery or other source of electrical current. The corresponding segments of *A'* are respectively connected to ground through relays. If, for instance, levers 1 and 2 were raised so as to engage the battery or active contact points, the arm in sweeping over quadrant *A* would transmit two electrical impulses over the line which would pass through the corresponding segments of quadrant $A^1$ at station *X* and energize the relays 1' and 2'. The next instant the contact arms would sweep over quadrants *B* and *B'*, sending a set of impulses to relays controlled by *B'*, etc. The relays of each quadrant operate their own printing mechanism. Of course, the diagrams do not show the exact mechanism employed in this system, but merely illustrate the broad principle of operation, showing how four signals can be sent on a single wire by four different operators, and sorted out at the receiving end so as to operate four different printers. Then, by means of a duplexing system, signals can be sent over the same wire in a reverse direction from station *X* to *Y*, so it is possible to transmit eight messages over a single line.

One of our photographs shows a multiplex table equipment with only one transmitter and one receiver, which serves to illustrate the various apparatus required. Of course, for a complete quadruplex-duplex system this equipment would be increased four-fold. By operating the keyboard a paper tape is perforated, and this passes through the transmitter, where a set of fingers bear against the tape and, operating through the perforations, raise the levers corresponding to those shown in Fig. 1, thus sending impulses over the line as selected by the arrangement of the perforations. The tape moves through the transmitter with a step-by-step movement. Each transmitter is connected to its own ring quadrant of a distributor. As shown in one of the photographs, the distributor is provided with a series of rings which we cannot attempt to explain in detail in this short article. Suffice it to say that this distributor combines the rings of both the receiving and transmitting stations. Of course, the signal sent will operate only the printer at the distant station and not the one shown in the photograph, for this is operated by the transmitter of the distant station.

It will be realized that, in order to prevent overlapping of signals, the contact arms of the distributors at the two stations must run at exactly the same speed and in perfect unison. Otherwise, an impulse sent on segment 3 of station *Y* might be received on 4' or 2' of station *X*, if the contact arm *E'* were running fast or slow. In order to maintain absolute synchronism, an automatic controller is employed, which is located directly behind the tape-operated transmitter. This apparatus is shown, with cover removed, in one of our photographs. The motors are of the phonic-wheel type driven by the impulses of an electrically driven tuning fork. The latter may be seen at the top and rear of the photograph. By means of this system a very accurate control of speed may be obtained. However, the arrangement is such that one motor will rotate a little faster than the other, and when it has gained a certain predetermined angle it is set back by automatic means. This apparatus is also arranged to stop the transmitter if the operator is unable to keep pace with the distributor. Ordinarily, the tape forms a loop between the keyboard mechanism and the transmitter, and into this loop projects a lever from the automatic controller. When the transmitter operates fast enough to pick up all this slack, the tape raises the lever of the controller, which serves to check the action of the transmitter, delaying it until the operator has accumulated enough slack in the tape to release the lever of the controller.

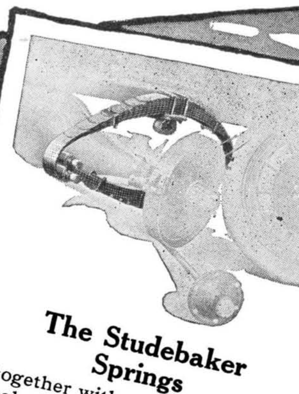
(*Concluded on page 440.*)





**The Studebaker Motor**

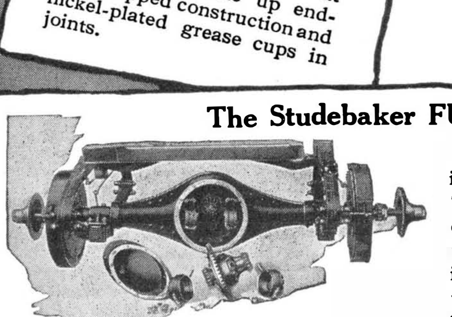
is the long-stroke, high-speed type—powerful and silent in operation—simple in design and extremely accessible in every one of its details. Remarkably economical of fuel owing to improved design of gas passages, valve openings and manifold.



**The Studebaker Springs**

together with the remarkable balance of the chassis have made this FOUR one of the EASIEST-riding cars on the road. Long, flat wide, TRIPLE-life springs of Studebaker steel—semi-elliptic in front, full-elliptic underslung in rear. Spring-shackles at both ends to take up end-play—lipped construction and nickel-plated grease cups in joints.

**The Studebaker FULL-floating Rear Axle**



is not merely a "floating" type of axle—but a real FULL-floating rear axle in which the axle housing carries the weight of the car. TWO Timken Bearings in each hub take up the side-thrust and the shaft itself is left free merely to turn the wheels. It is the SAFEST and most accessible type of rear axle. Studebaker designed and Studebaker built.

# What $985 will buy —because it's a Studebaker

At the first glimpse you get of this Studebaker FOUR you'll begin to appreciate the evident QUALITY that Studebaker has built into its every detail, simply "—because it's a Studebaker."

For you'll find it one of the handsomest cars you ever saw. A car of distinctive design—refined and graceful in line with a rare elegance of finish that few cars at any price can match.

And you'll notice, too, the roominess of this attractive car—and the handsome CROWN fenders and the wide doors with hidden hinges and catches, and deep, restful cushions finished with high-grade, hand-buffed leather. And a hundred other little details that lend beauty and grace to its looks.

But it is only when you study the mechanical construction of the car itself that you realize how much you can buy in this car at $985—how needless it is to pay more for a FOUR—and how unwise, too, it may be to pay less and sacrifice quality—QUALITY you must have, and this is the ONE car that can fully satisfy you on every quality point at a price below one thousand dollars.

The rear axle, for example—it's not merely a "floating" type. This FOUR has a FULL-floating rear axle. It's the most expensive form of axle—but it's the safest and the easiest to get at.

You'll find that instead of following the less expensive construction of driving thro' springs, Studebaker uses TWO radius rods and a torque arm for the drive. The springs are free to take up the jolts and jars—and nothing else.

You'll find brakes of ample size to insure safety at all times on any roads. And a brake-equalizer of the highest type.

You'll find a silent and flexible motor that gives road-mastering power and yet is marvelously economical.

You'll find Timken bearings at every point of HARDEST wear—13 of them in all. Is there any other car at less than a thousand dollars that can give you as many?

You'll find a Studebaker-developed Electric System that never fails. And so in every detail you'll find the QUALITY that Studebaker must put into the Studebaker FOUR "—because it's a Studebaker."

But see this car—stand it side by side with other FOURS—no matter what the price. And judge its quality and what it gives, and then, when you know that you can get all this at $985—backed by the $45,000,000 guarantee of that name of Studebaker—you'll begin to realize that Studebaker QUALITY is not merely an empty phrase.

**STUDEBAKER — Detroit**

**Canadian Plants: Walkerville, Ont.**

***Studebaker Features*** Electric Lighting and Starting—FULL-Floating Rear Axle—Timken Bearings—Safety Tread Rear Tires—One-man Type Top.

| | Price in U. S. A. | Price in Canada |
|---|---|---|
| Studebaker ROADSTER, - - - | $985 | $1250 |
| Studebaker LIGHT SIX, - - - | 1385 | 1750 |
| Studebaker SIX (7-passenger), | 1450 | 1825 |

## The Second-hand Automobile

(*Concluded from page 435.*)

all kinds of sharpening on his little car, picked up for a song and built over by his own hands. An inventor has constructed a heavy tractor from an old but powerful car, which serves as a model from which his standard tractor will be manufactured. A dye establishment operates a cheap second-hand car with a striking body, for delivery and advertising purposes. Ranchers have found the medium power used car available for heavy work, such as plowing and threshing, when used in connection with a gear-reducing device. One car of foreign make, built in 1902 and brought to Colorado in 1903, is still doing useful work, but now as a plow instead of a pleasure vehicle.

In fact, it seems as if the second-hand car is a very valuable aid to modern business in supplying a great deal of power for a very small amount of cash.

## A System of Long Distance Typewriting

(*Concluded from page 438.*)

At one side of the automatic controller may be seen a sector provided with finger-holes marked "plant," "stop," "repunch," etc. This permits of sending bell signals over the line by pulling the sector against a finger stop and then releasing it.

The printing mechanism is shown in one of the photographs with cover removed. Needless to say it is too complicated to be described in a few words. We can merely refer to some of the parts indicated by the reference numerals. The typewheel and ink rollers are shown at 1, the selecting disks at 2, and the motor at 3. The mechanism that moves the carriage and the paper in front of the typewheel is shown at 4, while 5 is the printing unit, 6 the paper carriage, and 7 the paper-lift magnet unit.

The average speed of telegraphy with the Morse system is about 25 words per minute. With the Murray system, 80 to 90 words per minute each way have been transmitted, that is, 170 words per minute. With the new combined Baudot and Murray system each operator can send on an average 45 words per minute, and as there are four operators sending from each station, we have a total of 360 words per minute on a single line as the average of the new system.

## The Psychology of Batting in Baseball

**By Arthur Macdonald**

WHILE witnessing recent games, I asked myself what was the most obvious general defect. It seemed to be the batting, and especially the knocking of high flies which are almost always caught. The pitching, base running, and fielding seemed to be much better done than the batting.

The value of heavy hitting cannot be overestimated. Some of the types of batters are those who hit anything and everything all the time, like Delehanty, who made four home runs and a single in five times at bat in one game.

There are a few, like "Home Run Baker," who do not make a long sweep at the ball, but hit with a short, sharp stroke, the force of which is increased by movement of shoulders, forearm, and body, as well as strength of wrists. Players of this type have a good chance of hitting the ball about the time it begins to curve, and so are surer batters.

Then there are the so-called "sluggers," who make a long sweep of the bat backward and forward again, but usually not in time to strike the ball squarely, and so are often very uncertain as to the outcome.

About thirty years ago, I used to organize in summer vacations an amateur team who played the game as long and with as much enthusiasm and earnestness as it is done to-day. The principles of the game have not changed, but there have been, of course, variations and changes in the rules. I was in the habit of knocking up for the boys in practice what were called very high flies, and this habit had become so fixed that when I went to the bat I was almost sure to knock a fly, and



## INQUIRY COLUMN

READ THIS COLUMN CAREFULLY. You will find inquiries for certain classes of articles numbered in consecutive order. If you manufacture these goods write us at once and we will send you the name and address of the party desiring the information. There is no charge for this service. *In every case it is necessary to give the number of the inquiry.* Where manufacturers do not respond promptly the inquiry *may* be repeated.

MUNN & CO., INC.

*Inquiry No. 9426.* Wanted the name and address of a manufacturer who can make 5/8" buoyant balls made into perfect spheres in large quantities. They are intended to take the place of cork. Possible wood pulp might be used.

*Inquiry No. 9427.* Wanted to secure patented device which is practical, not too expensive, and for which there is a real demand.

*Inquiry No. 9428.* Wanted to secure an interest in a manufacturing concern. Will buy part or entire interest. Must be a going concern.

*Inquiry No. 9429.* Wanted the name and address of a manufacturer of a machine for bleaching beeswax.

*Inquiry No. 9430.* Wanted the name and address of a manufacturer who can supply machinery for producing soluble coffee.

*Inquiry No. 9431.* Wanted to purchase a mold for shaping and piercing beads made of rose leaf of the consistency of dough.

*Inquiry No. 9432.* Wanted the name and address of a manufacturer of watch glasses 9 inches in diameter.

*Inquiry No. 9433.* Wanted the name and address of a manufacturer of a material such as is used by gas mantle makers. The material is used to cover the wire frame that supports the mantle at the top and is used to protect the wire from the flame or heat of the mantle.

*Inquiry No. 9434.* Wanted the name and address of a manufacturer of special pins, 1/16 of an inch in diameter and 3/4 of an inch long, the pins to be made of bone.

*Inquiry No. 9435.* Wanted the name and address of a manufacturer who can furnish grinding machines for the hollow grinding and finishing of razors. Up-to-date machines wanted.

*Inquiry No. 9436.* Wanted the name and address of a manufacturer of rat traps having a receptacle attached into which the rat drops and drowns.

*Inquiry No. 9437.* Wanted the name and address of a concern that can make an oil or grease gun. West preferred. Must be able to make in quantities of 10,000.

*Inquiry No. 9438.* Wanted the name and address of a manufacturer of light aluminium sheets, small tubing, rods and wire, also aluminium solder.

*Inquiry No. 9439.* Wanted the name and address of a manufacturer of a knitting machine which was on the market some years ago. The name of the machine was the Bickford Machine. It was a hand knitting machine, weighing about 15 pounds.

*Inquiry No. 9440.* Wanted the name and address of a concern selling Dr. Young's E-Z Sanitary Belt.

*Inquiry No. 9442.* Wanted the name and address of a manufacturer of a machine for cutting skeins of cotton and wrapping each bundle around the middle with wire. A machine of some such kind is used in the brush trade for wiring and cutting to length the bundles of bristles for paint brushes.

*Inquiry No. 9443.* Wanted the name and address of manufacturers of fuel oil burners and fire wall equipment, suitable for a maximum quantity of water evaporation in a locomotive firebox of the following dimensions: 2½' between door and flue sheet, 3' between grate level and crown sheet, 3' between side walls.

*Inquiry No. 9444.* Wanted the name and address of a manufacturer or patentee of a glass preserving jar made for use with air pumps for creating a vacuum.

*Inquiry No. 9445.* Wanted the name and address of a manufacturer who can make a combination pencil holder and point protector.

often get out; and the only compensation for this weakness was an occasional home run. So I made it a rule that no member of the team should ever throw up and knock flies for another player, but always try, both in practice and games, to knock grounders, when no base runner need wait, as in flies. The main point is that every time we swing the bat upward, or in such a way as to hit flies, we tend to form a bad habit. But if we always strive to strike downward, or in such a way as to knock grounders, we will tend to form what seems to me the best possible batting habit.

While, of course, there may be conditions where grounders might not be the best play, yet it is unwise for the sake of a temporary advantage to weaken in the least the good habit of muscular movements that tend to knock grounders, the most difficult balls to handle, and which are often fumbled, especially when the men are a little nervous or excited. Fumbles under such conditions frequently lead to bad throws to bases, which are liable to pass the baseman and cause disastrous results.

In discussing with a prominent trainer the question of batting, he said the difficulty was in following any rule on account of the unexpected various curves and drop balls. But this is no answer to a fact of muscular memory, that a fixed habit of such movements of the arm, wrist, and body as tend to knock grounders will also tend to lessen the number of flies. It is not meant that this or any rule should be followed absolutely, for there may be players with idiosyncrasies where a rule should be modified.

*Batting Makes Games More Interesting.*—Batting is called the blood of the game, and when it is poor, it is like a boxing match where the defense is so much better than the offense, that not a blow is landed.

If baseball is in the future to be successful as in the past, the games must be made as interesting as possible to the spectator. One way to do this is to make the batting more effective. There is nothing that thrills the spectators more than to hear the loud sound of the ball on the bat; they often rise to see where the ball is going. No matter how strong the habit of knocking grounders may be, flies will occur, but they are more liable to be long ones or liners and lead to a home run, which is always exciting. When a high fly is hit there is little interest manifested, as it is assumed, and almost always correctly, that it will surely be caught.

Keeping down the scores to small figures seems to have become a fetish, as high figures are supposed to indicate poor playing. If the batting be improved, the scores may be larger, but this would not necessarily mean that the game was a poor one. On the contrary, there can be better fielding and better batting at the same time, making a lively game and affording more opportunities for brilliant fielding. There might be more errors, but this does not indicate at all that the fielding was poor, but that it was more difficult because of better batting.

*Some Causes of Weak Batting.*—Specialization is one of the main causes of weakness in batting. Many years ago a first baseman or catcher, who could not bat, was not wanted. In addition, special study is given to the batter's habits at the plate, as to what kind of ball troubles him and where he is liable to hit. The foul strike also gives the batter less chance, and larger gloves than necessary for protection (their original purpose) have increased the fielder's opportunities against the batter.

*Individual Bats for the Teams.*—Batting now is for the sake of team work, to advance runners and score, rather than make base hits. Often a batter must permit just the kind of ball he can hit to go by, and then strike at one he is lucky even to touch. He may be ordered to wait and let the pitcher weary himself. Some batters can put off fouls and help to tire the pitcher out. If by waiting a batter can get three balls, foul off three, and then strike out, he may aid the team more than if he had made a base hit off the first ball

pitched. For a pitcher pitches about 125 balls in a nine-inning game, and every additional ball may weary him. Rallies in the ninth inning are often the result of waiting by batters who struck out during the former part of the game.

Other batters try to get hit by the pitcher. In most cases any contortion of the arms is so construed, especially by the home crowd. Some push their knees out toward the ball. A batter once stuffed his shirt out six inches and inflated his trousers to give more surface to be hit.

In order to counteract many of his disadvantages, the batter should watch the pitcher and study him carefully, and keep his mind off the bleachers. If he has a slump in his batting, it is generally due to bad physical or mental condition, when he is liable to swing too soon or too late. In practice he should have a pitcher serve him straight swift balls at first until he can get his batting eye back. It has been suggested that one way to help batting might be to enlarge the foul lines a little.

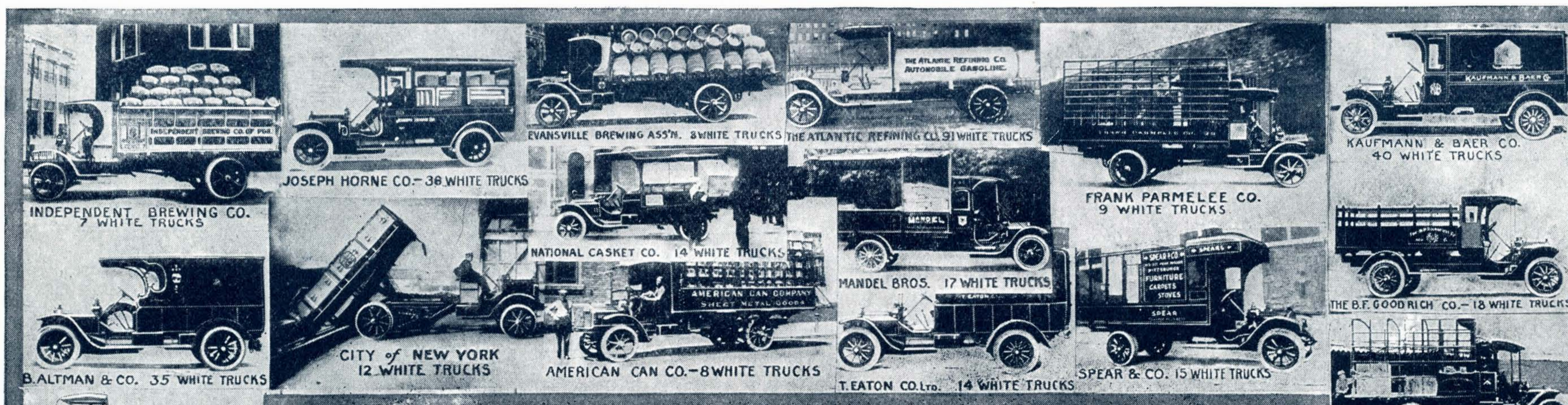
When a great batter is slumping, he may knock the ball just as hard and often, but not in a safe place. But some experts regard place-hitting more or less a matter of chance. At times one is often contented to be able to hit the pitcher at all. Batting is harder to do than fielding. Everybody has a chance to bat, yet there are many more good fielders than good batters. A team of good batters is likely to win the last games of a series, as they come to understand the pitchers better.

*Difficulty to Teach Batting.*—It is very difficult to teach a man to bat. He must have the eye to tell what the ball will be. A fast ball, breaking close, will not make its jump until about four feet from the plate. Four feet is one fifteenth of the distance from pitcher to batter. A fast ball travels 68 feet in seven eighths of a second, allowing an eighth of a second for the wind-up, so the batter has six eighths of a second, or less, to decide whether or not a pitched ball is going to come over the plate, whether or not it is going to come in or out, up or down, and whether he had better strike or wait.—From *American Physical Education Review.*

### Good Roads Legislation

TO aid legislatures in revising road laws and framing new road legislation, a series of papers dealing exhaustively with existing road laws in each State will be issued under an arrangement made by the Legislative Committee of the American Highway Association with the Bureau of Municipal Research of New York city. The complete compilation of road laws already thoroughly indexed and brought up-to-date has been submitted by the committee to A. N. Johnson, Highway Engineer of the Bureau of Muncipal Research, for use in the preparation of a series of papers and charts which will indicate the laws in each State which are conflicting, obsolete, vague or superfluous, and the lines along which simplicity and efficiency in revision may be obtained. Included in the publications to be issued will be suggested models for laws covering State aid to road improvement; the use of convict labor; the issuing of bonds for road construction; the management of local roads; the regulation of traffic, and other related subjects of legislation. Charts illustrating graphically the points of similarity and dissimilarity in the respective State systems will also be prepared.

The American Highway Association, through its Legislative Committee, first secured the effective aid of the United States Office of Public Roads in compiling all road laws and the work which will now be done by the Bureau of Municipal Research is a further step in turning this great fund of information to best advantage. The third step in this important undertaking will comprise personal conferences and hearings in connection with State legislative programmes by experts whose services will be arranged for by the Highway Association. In its field propaganda work the association is represented by Charles P. Light, field secretary, and its office headquarters work in Washington is in charge of I. S. Pennybacker, executive secretary.






# White Building Makes White Truck Performance a Law unto Itself in Length as in Perfection of Service

COMPARISONS may be "odious" but they eliminate the unfit.

The comparative test of side-by-side service is the only fair way to find out which truck is doing the work steadiest, at lowest cost and for the longest time. Because of such tests White Trucks predominate in most large fleets in the country.

Faithfully, year in and year out, a White can be relied on to do your work at a big saving per ton mile. It keeps, practically, in constant commission, and operates with mechanical perfection which is almost a "thinking" intelligence.

And in a short time it pays for itself with big dividend on the investment. And long after the time when, judged by ordinary standards, it would have ceased to exist on the company's books, the White keeps on going.

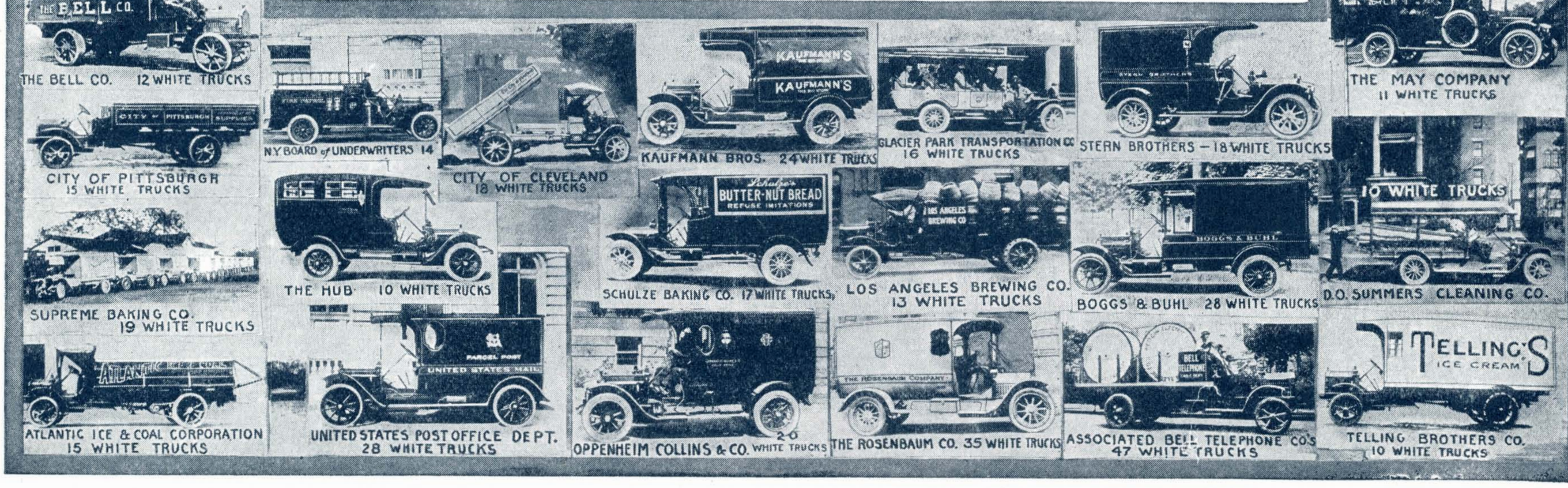
It stays on the job; it defies the junk pile; it knocks into a cocked hat all previous ideas of motor truck "depreciation."

Efficiency reasons dispose of the laggards in all departments of the world's work. They explain the striking preponderance of White Trucks. Ask any White owner; he has figured it out in dollars and cents.

We shall be glad to make suggestions on *your* trucking problem.

***Exhibiting at the Transportation Building, Panama-Pacific International Exposition, San Francisco***

**THE WHITE COMPANY**
CLEVELAND
LARGEST MANUFACTURERS OF COMMERCIAL MOTOR VEHICLES IN AMERICA

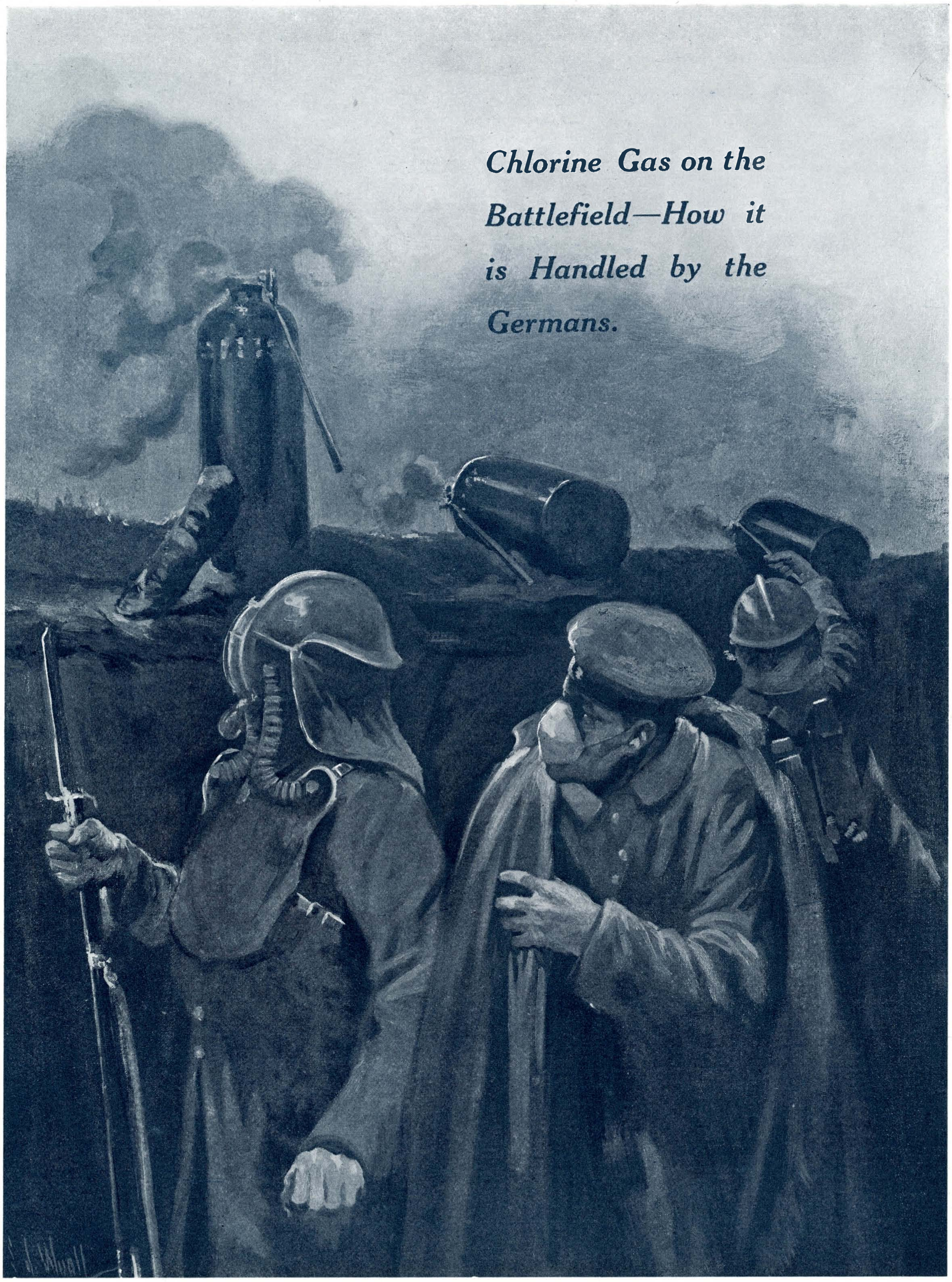



***Since these illustrations appeared in the Scientific American advertisement, February 27th, it has been necessary to remake this plate because 111 trucks have been added to above fleets***

**NOTE—In last 10 days 29 additional White trucks have been delivered, thus making total 140 in place of 111**

| | |
|---|---|
| New York | Broadway at 62nd Street |
| Chicago | 2635-2645 Wabash Avenue |
| Philadelphia | 216-220 North Broad Street |
| Boston | 930 Commonwealth Avenue |
| San Francisco | Market Street and Van Ness Ave. |
| Baltimore | Mt. Royal and Guilford Avenues |
| Pittsburgh | Craig Street and Baum Boulevard |
| Atlanta | 63-65 Ivy Street |
| St. Louis | 3422 Lindell Boulevard |
| Washington | 1233 20th Street, N.W. |
| New Orleans | 750 St. Charles Avenue |
| Newark | 33-35 William Street |
| Seattle | 1514 Third Avenue |
| Memphis | 278-280 Monroe Avenue |
| Dallas | 2025-2027 Commerce Street |
| Toronto | 14 Alexander Street |
| Montreal | Forum Building |
| Winnipeg | 230 Fort Street |

Scientific American

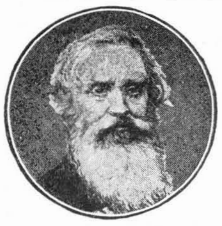



Vol. CXII. No. 20
May 15, 1915

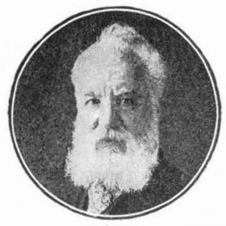
Munn & Co., Inc., Publishers
New York, N. Y.

Price 10 Cents
$3.00 A Year


ERICSSON


MORSE


EDISON


BELL


BLANCHARD


WESTINGHOUSE


WILBUR WRIGHT


ORVILLE WRIGHT


TESLA


MARCONI

# *The* 70th Anniversary *NUMBER of the* SCIENTIFIC AMERICAN

**June 5th, 1915**

THE Scientific American was founded seventy years ago, at a time when the United States of America was industrially less developed than South Africa at the present time. Even territorially, it was not the same country we know now; for California, Texas, and the great Southwest belonged to Mexico.

During that long period of seventy years the Scientific American faithfully chronicled the technical and industrial progress which we Americans made. Its editors saw the advent of the reaper, the telegraph, the telephone, the great trans-con-


THE SCIENTIFIC AMERICAN OFFICE 1859

tinental railways, the laying of the transatlantic cable, the development of the giant steamship, the perfection of the phonograph, the glow of the first electric incandescent lamp, the coming of the motion picture machine, the miracles wrought by wireless telegraphy, and more recently the conquest of the air.

What an age of wonders it has been! What a transformation has been wrought upon the face of the earth! Surely no tale of the Arabian Nights, no fantasy of Jules Verne depicts marvels so amazing as those which the Scientific American has been the first to describe authoritatively as soon as they appeared. Who would have thought, seventy years ago, that with the aid of the X-rays we could look through a man's body; that friend could talk with friend from New York to San Francisco; that Niagara Falls would illuminate cities; that street cars would move magically through our towns without any apparent means of propulsion; that pictures would be sent by wire from New York to Chicago, and that by means of the boundless ether a solitary passenger ship on a desolate ocean still keeps in touch with civilization.

It has been the privilege of the Editors of the Scientific American to know the men whose master minds have wrought these things, and to hear from their own lips the story of their struggles and their triumphs. Ericsson, Morse, Edison—the whole dynasty of inventive genius which has made the nation what it is—the editors have known them all.

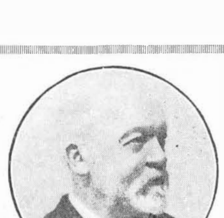

Copyright by B. G. Mitchell.

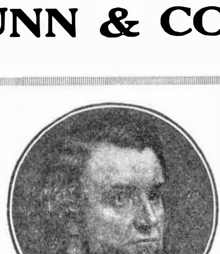
THE SCIENTIFIC AMERICAN OFFICE 1915

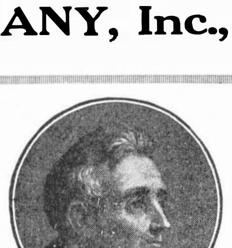
Seventy years is a turning point not only in the life of man, but in the life of any enterprise. It seems fitting that the occasion should be commemorated by the publication of a number which will review the progress that the United States of America has made in the three-score years and ten of our existence.

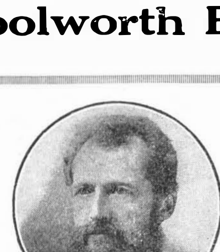
In June a number will appear which the Editors hope will do full justice to the great theme of American invention—a number which will transport us all back to the time when our fathers and our grandfathers still burned candles, when horses pulled street cars, when there were no automobiles and when the steam railway was a curiosity that people would travel miles to see. The motion picture machine of industrial progress will be turned backward, and the flickering film will make you wonder what the future will have in store if so much that is wonderful has happened in the past.

**MUNN & COMPANY, Inc., Woolworth Building, New York**

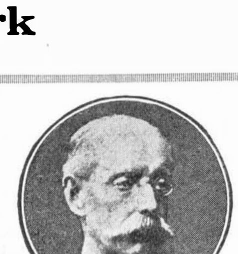

DAIMLER


McCORMICK


HENRY


MERGENTHALER


HOWE


PARSONS

SEVENTY-FIRST YEAR

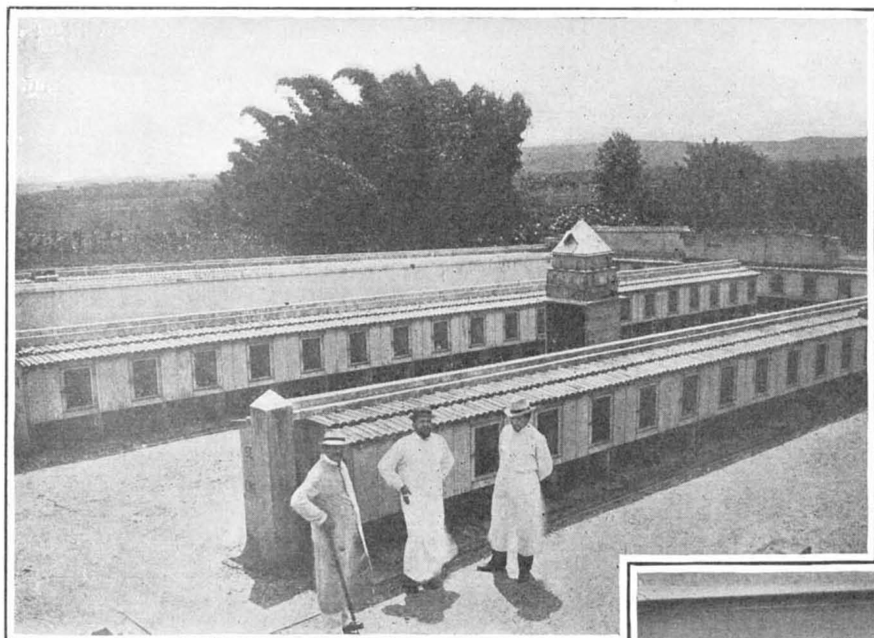
SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

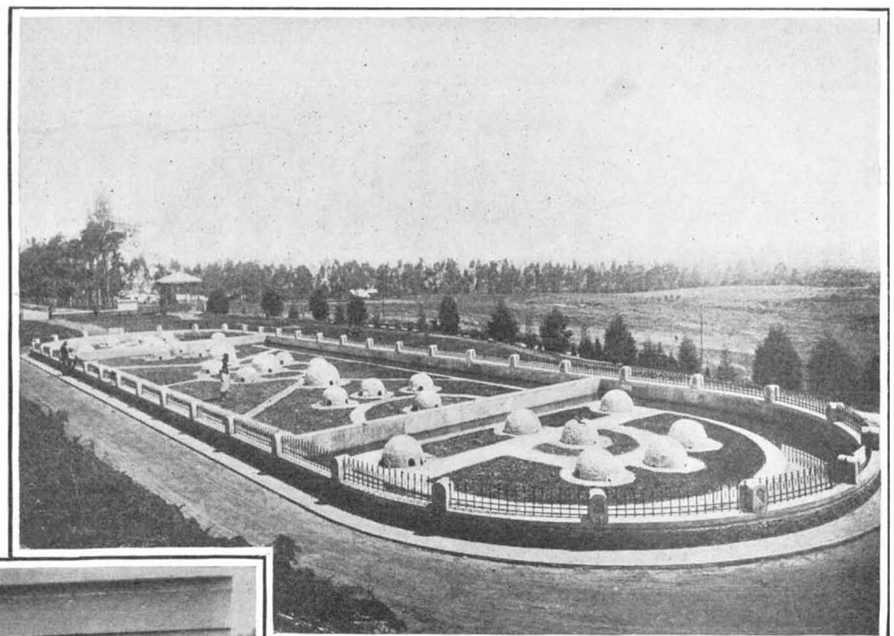
VOLUME CXII.
NUMBER 20.

NEW YORK, MAY 15, 1915

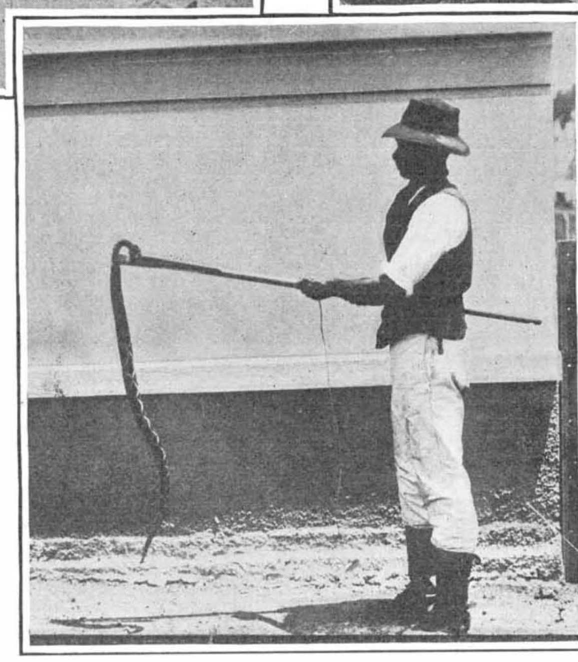
10 CENTS A COPY
$3.00 A YEAR



**Pens for small animals.**



**The garden of serpents.**



**Capturing a venomous snake with a forked stick.**

## A Garden of Serpents

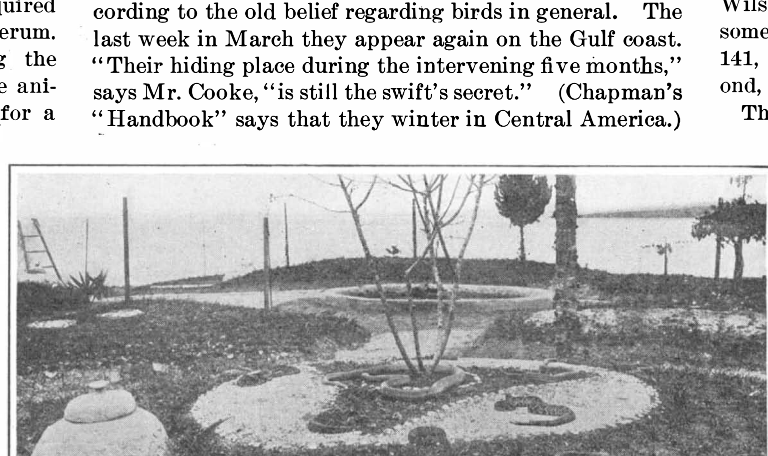
In the Serotherapic Institute of Brazil, which occupies a tract of 700 acres at Butentan, Dr. Vital Brazil produces serums for the cure and prevention of the effects of snake bites. The snakes used in preparing the serums are kept in a small park, containing numerous dome-shaped shelters, which is surrounded by a wall and a ditch filled with water. Other specimens are kept in a similar park, near the main building, in order to study their habits, favorite food, the very diverse venomous properties of various species, and the best method of escaping their attacks. The hot and moist forests of Brazil swarm with venomous serpents, but the slightest noise alarms the peaceful and timid reptiles, which attack only those persons and animals that tread on them or destroy their lairs. The principal families are the Bothrops and the Crotales, or rattlesnakes. The Bothrops venom decomposes the blood and produces internal hemorrhage, with intense congestion of the liver, kidneys, and brain, while the venom of the Crotales paralyzes the respiration, circulation and vision, and usually causes death within 24 hours. Each venom requires its special antidote. Dr. Brazil prepares a serum for each, and also a polyvalent or compound serum, which is effective against all Brazilian snake venoms, for use when the species of the attacking snake is unknown.

The serums are obtained from young and sound horses and asses, which receive, at intervals of 5 or 6 days, injections of venom, increasing from one twentieth milligramme to one gramme. A year's treatment is required to produce perfect immunity and an effective serum. The polyvalent serum is obtained by injecting the venoms of Bothrops and Crotales alternately. The animals thus immunized furnish anti-venom serum for a long time, if they receive a fresh injection of venom after each extraction of serum. Tubes of serum, with hypodermic syringes, are sent gratuitously to hospitals, municipalities and poor patients. Others are sold at low prices or exchanged for live snakes. In 1913 about 900 tubes of rattlesnake serum, 800 of Bothrops serum, and 4,500 of polyvalent serum were distributed, and 4,500 snakes were received. Serums for pest, diphtheria, and tetanus also are produced by the usual methods.

In the course of his study of Brazilian serpents, Dr. Vital Brazil has discovered a nonvenomous constrictor snake, the *mussurana*, which is naturally immune to snake venom, and which kills venomous snakes by crushing them in its coils, and then devours them.

It is a remarkable fact that the serums prepared at Lille by Dr. Calmette, the originator of the serum treatment for snake bites, are powerless against the venom of Brazilian serpents.—*Abstract of an article by Jacques Boyer.*

**A Bird Mystery.**—One of the most curious and interesting of the unsolved problems relating to bird migration, according to Mr. W. W. Cooke's recent memoir on this subject, is connected with the chimney swift, more often called the chimney "swallow," a very common and well-known bird of the eastern United States. After the breeding season the flocks drift slowly south and concentrate in vast numbers on the northern coast of the Gulf of Mexico. Then they disappear as completely as if they hibernated under the water or in the mud, according to the old belief regarding birds in general. The last week in March they appear again on the Gulf coast. "Their hiding place during the intervening five months," says Mr. Cooke, "is still the swift's secret." (Chapman's "Handbook" says that they winter in Central America.)



**Some inmates of the Garden of Serpents.**

## High-speed Stars

In order to obtain more exact figures in connection with the sun's motion through space and other similar problems, astronomers are measuring the velocity and direction of a great number of stars, which, like the telegraph poles along a railroad track, seem to go rapidly backward as we move forward.

The fact that these stars have motions of their own complicates the case considerably, for the "fixed stars" are known to be moving in great streams and change their positions not only in relation to our solar system, but also in relation to each other.

The motion of a star naturally resolves itself into two parts: one measured along the line of sight representing its amount of approach toward us or its retreat, the other measured at right angles to a line drawn from the star to the observer.

The first of these motions is measured by a study of changes in the star's spectrum, the second by comparing its position as measured accurately at dates many years apart.

The velocity of a star seems to be a factor of its effective age. Unlike our ordinary human experience, the speed of a star increases with its advancing years, and in the whirl of spheres above us it is the young who cannot keep the pace.

The average velocity of stars ranges from about 6 kilometers, or between three and four miles, per second for "young" stars to about 30 kilometers per second for "old" ones. But notable exceptions occur. At Mount Wilson Solar Observatory of the Carnegie Institution some stars have been found to move with velocities of 141, 150, 179, 233, 316 and even 325 kilometers per second, the highest speed yet known.

These high velocity stars are sometimes described as runaways, because they seem to be quite beyond the control of the gravitational power of the universe. At their speed the attraction of the entire known stellar system would be wholly insufficient to check the star's career through space.

The astronomer, Simon Newcomb, once calculated that the maximum velocity attainable by a body starting with velocity zero at an infinite distance and passing through a stellar system containing one hundred million stars each five times as massive as our sun and distributed throughout a disk-like spheroid of certain extent cannot exceed 40 kilometers per second. Yet the star "Groombridge 1830" has a speed nearly nine times this value, and the massive star Arcturus has a speed probably four times this value.

If existing velocities owe their magnitudes to the gravitation of the system, the quantity of attracting matter in the whole stellar system would have to be at least eighty times that assumed by the calculations of Prof. Newcomb.

# SCIENTIFIC AMERICAN

**Founded 1845**

**NEW YORK, SATURDAY, MAY 15, 1915**

Published by Munn & Co., Incorporated. Charles Allen Munn. President; Frederick Converse Beach. Secretary; Orson D. Munn. Treasurer; all at 233 Broadway, New York

Entered at the Post Office of New York, N. Y., as Second Class Matter
Entered as Second Class Matter at the Post Office Department, Canada.
Trade Mark Registered in the United States Patent Office





**Subscription Rates**

| | |
|---|---|
| Subscription one year | $3.00 |
| Postage prepaid in United States and possessions. Mexico, Cuba, and Panama | |
| Subscriptions for Foreign Countries, one year, postage prepaid, | 4.50 |
| Subscriptions for Canada, one year, postage prepaid | 3.75 |

**The Scientific American Publications**

| | |
|---|---|
| Scientific American (established 1845) per year. | $3.00 |
| Scientific American Supplement established 1876. " " | 5.00 |
| American Homes and Gardens " " | 3.00 |

The combined subscription rates and rates to foreign countries including Canada, will be furnished upon application.
Remit by postal or express money order, bank draft or check

**Munn & Co., Inc., 233 Broadway, New York**

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp* the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

*The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.*


## The President and Our People

As our readers very well know, during the heart-rending struggle which has been taking place in Europe during these many months, the Scientific American has maintained an attitude of neutrality. It has endeavored to follow out strictly the injunction of the President at the outbreak of the war. It has witnessed with concern and with feelings of horror the many acts which have been committed in the name of war. It has felt that it was the part of every American citizen, however, to refrain from showing any active partisanship in this crisis. During the last few weeks, however, the nature of the war has changed, and not only the feeling but the demand for a strict moral neutrality has been disturbed by certain acts of the Teutonic allies, which cannot be excused or palliated. We refer, of course, to the attacks which have been made upon shipping of neutral nations. Ships of the United States, Holland, Sweden, and Norway have been sunk without warning, and the flag of these countries has been no protection against these acts of depredation. The people of this country have viewed with the gravest anxiety the apparent systematic policy of the German government to carry out its imperial will irrespective of the rights of nations or of individuals. The horror following the sinking without warning of the "Lusitania" only emphasizes the shocking character of the situation. Has this ceased to be a war of army against army and degenerated into a war against civilians and women and children, no matter of what nationality?

This is the first instance in the history of mankind where a regular transatlantic liner, filled with civilians of many nationalities, has been deliberately sunk on the high seas, and this act was committed, not after allowing innocent women and children to escape in lifeboats, but wantonly and wickedly without allowing the victims of the weapon of destruction any chance for their lives. It cannot be claimed that this act was the irresponsible whim of the commander of the submarine, for an advertisement appeared in the American press prior to the sailing of the "Lusitania" warning passengers against sailing on the high seas. It would seem evident from this warning that this horror is the result of the deliberate policy of the imperial will.

During the first months of the war the imperial government sent its apologists to this country to try and explain away the crime against Belgium and the wanton destruction of some of the choicest works of art of Europe; but their arguments and pleas failed to convince, because our people felt that such matters could not be solved by the thumb rule of a lawyer's brief. Our people do not accept as a mandate the claim that "war is war." They have the highest respect for and belief in the justice of international law, but such a code has limitations which do not harmonize with the ideals of the American people, who realize that there is a higher law—the law of humanity and civilization—which is being outraged and trampled upon. And it is for that reason, and in spite of the calm and generally neutral attitude of the American press, that underneath there has been a strong current of opinion among the American people, which absolutely condemns the methods of war now being conducted by the Teutonic allies.

The Scientific American wishes to enter its protest against these acts. It fears for the future of civilization if such acts are accepted under any plea which does violence to the accepted codes of warfare.

In this country there are some 10,000,000 of American citizens of German birth or German descent. They may be considered among our most enlightened, intelligent, and staunchest citizens. At the time of our civil war they rendered inestimable service to the cause of the Union. They form an integral part of our body politic. He would be a poor thing, indeed, who would begrudge any native-born German the love of the country of his birth, but to such, as well as to native-born Americans, who have become imbued with the American spirit, we would appeal in the name of civilization and humanity that some effort be made to bring home to the friends on the other side a realization that the methods of war now being followed are entirely out of keeping with the ideals of liberty and the rights of humanity which this United States of America holds as its cherished possession. A grave responsibility rests upon the President of the United States at this crisis. It is a fortunate thing for the people of this United States that they have at the head of the Government one in whom they have every confidence, who all through this long and painful struggle has shown a wisdom, a patience, a conscientiousness, and a high-mindedness which have evoked the admiration of all American citizens. The rights of our citizens are being abused, the rights of humanity are being violated, and what course is it possible for us to assume? This we leave in your hands, Mr. President. It is against the tradition and the unwritten law of this land for us to engage in any European conflict; the policy of our Government for the last one hundred and twenty-five years has been so shaped that we are not prepared to engage in such a conflict; it is not our purpose or our wish. The establishment of a large standing army is contrary to the spirit of our people. We have neither the army nor equipment necessary for war, even did our wishes incline us in such a direction, so that such a policy is hardly to be entertained. Our fleet would be of little, if any, service in this invisible marine warfare. We are content to leave in your hands, Mr. President, the shaping of the course which this great nation should pursue, feeling that the rights of its citizens will be fully protected, and that its reputation for honor, for fair dealing and dignity will not be allowed to suffer.

## To the Hon. Josephus Daniels, Secretary of the Navy:

We have received from you a copy of a letter written by you to President Garfield of Williams College on the subject of the preparedness of the Navy, and in your letter of transmission you state that it occurs to you that we would be interested in this letter.

The letter does interest us exceedingly, partly as a statement of the excellent work which has been done for the Navy under your administration, but far more as a revelation of the spirit in which you are conducting the duties of the high office to which you were called, and which you now fill.

We have read your letter through more than once, and very carefully, and we have to confess that the strong impression left upon our minds is that you are more concerned to prove that the work done under your administration in building up and improving the Navy has been superior to that done under the previous administration than you are to show whether our Navy is in the condition of strength and preparedness relatively to the other navies of the world which the present very serious international situation demands.

To bring home to your mind why we consider that your point of view is rather the narrow political than the broadly patriotic one, we quote from your letter. You say: "What has been done since Wilson's inauguration to make the Navy stronger, in ships, in ammunition, in mines, in torpedoes? These questions are of the utmost importance. Let me answer them briefly: First as to the ships: During the last two years of the Taft Administration, Congress authorized the construction of two dreadnoughts to cost about $13,000,000 each. During the first two years of the Wilson Administration, upon my recommendation, Congress authorized the construction of five dreadnoughts to cost about $14,000,000 each." (We cannot forbear to remind you, just here, that one of those dreadnoughts was secured at the cost of two existing battleships of our Navy, the "Idaho" and the "Mississippi," which were sold to Greece.) "Stated in dollars, the Wilson Administration in its first two years authorized $70,000,000 to be spent on the chief fighting force of the Navy as against $26,000,000 authorized during the last two years of Taft's"; and so forth and so on.

Again, speaking of submarines, you say: "The Sixty-third Congress elected with Wilson adopted my recommendation to give us all the money it could for submarines. . . . These submarines will cost $16,260,000. Now, what was done during the last two years under Taft? Twelve submarines to cost $7,958,936 were authorized."

And again, under the heading of "The Savings Effected," you say: "During the four years of Taft, $21,928,572 was appropriated by Congress for the public work alone of shore stations. Two naval bills have been passed by the present Administration, and they carry together, for the public work of shore stations, a total of $3,920,880."

Finally, in the last paragraph of your letter to President Garfield, you make a statement which in one broad and bold proposition seems to indicate that you look at this subject as a political rather than a national problem. You say that one of the reasons for the length of your letter is: "Because certain persons, ignorant of their ignorance, and for selfish partisan reasons, have busied themselves with misrepresenting the true conditions of the Navy, thereby causing some good people to fear that the Navy is not now as in the past, the strong, effective, right arm of the republic."

Is it to be inferred from such a statement that you are of the belief that no one can criticise the naval policy of your administration except from political motives.

The interest of the Scientific American, and of every journal, technical or otherwise, in the United States Navy, and the interest of 90 per cent of the citizens of this great country in the Navy, is a patriotic one, and it has nothing whatever to do with politics.

The American public cares not one jot or tittle whether the Wilson Administration or the Taft Administration or any other Administration has done more or less than preceding or following Administrations have done, but it does care very much, indeed, whether the party in power is taking a broad and statesmanlike view of the situation; whether it is endeavoring to build our Navy up to a condition of strength and keep it in a state of preparedness, which will enable it to safeguard the vital interests of this country.

For many years the Scientific American has claimed that the root trouble with the Navy is that the question of appropriations has been made a political one; that Congress, instead of regarding the matter of naval and military preparation as a vital one to be placed far above all party politics, has preferred, year after year, to throw the recommendations of its naval experts into the political bag, to take their chances with the Pension Bill, the River and Harbor Bill, and the whole of those purely local and individual questions which make up the contents of what, not very euphoniously but very aptly, has been termed the "Pork Barrel." Whether Congress may realize the fact or not, there is no doubt whatever that the nation at large has awakened to the fact that our naval and military forces are totally inadequate for the onerous duties which are liable at any time to be laid upon them. The American people have learned the lesson of this terrible European war. They realize that the question of adequate armament is one affecting the very life and death of the nation. We believe that the whole country is in a frame of mind to treat this question as such, and we are perfectly certain that the very last thing that they care about, or wish to hear about, is whether the Wilson Administration or the Taft Administration spent the larger or the smaller number of dollars and added the larger or the smaller number of ships to our naval resources in a given length of time.

Somebody has defined genius as the possession of a strong sense of proportion, and we cannot help but feel that in this hour of stress and danger there is a strong call for genius of this stamp.

## Cannonading and the Weather

The wet winter in Europe has brought forth the inevitable suggestion from many quarters that the cannonading incidental to the war had something to do with it. The excessive rainfall, as compared with the normal, appears, however, to have been greater in the British Isles than on the Continent; in other words, not only at a considerable distance from the main theater of war, but also to windward of it. British rainfall during November to February was about 50 per cent above the normal. As to the Continent, Camille Flammarion points out that October, 1914, was a dry and sunny month, in spite of the tremendous battles then in progress; that the rainy periods during the winter coincided—exactly as in the piping times of peace—with the advent of cyclonic disturbances from the Atlantic Ocean; and that the recent rains are by no means without precedent in normal times. The veteran astronomer cautiously adds, however, that we must not be hasty in drawing conclusions either *pro* or *con*.

**Concrete Gasometer Work.**—Reinforced concrete is now coming into successful use in the construction of gasometer basins. A recent example of the Hennebique concrete system is noted in a circular basin of this kind which was recently built at St. Sebastian, Spain, and it is the first example to be found in that country. Diameter is about 80 feet, and height of basin 26 feet. Around the basin are enlargements in the shape of 9 buttresses in order to add to the strength of the construction, and each buttress serves as the base for one of the structural iron beams which go to make up the gasometer framework and support the gas-holder.

## Notes on the War

**German Foresight.**—Speaking of German foresight, Hilaire Belloc says that in his power to maintain close formation; in the use of high-explosive shells on permanent fortifications, and in the use of heavy pieces in the field, the German has proved that his theories of modern war were correct. The advantage in material is slowly passing to the Allies.

**Long-range Bombardment.**—The astonishment which was aroused by the fact that the Germans were able to bombard Dunkirk from a distance of over 20 miles was confined entirely to the lay public; for military men, and particularly artillerists, have long known that it was possible to throw shells to a distance of 20 and even 30 miles if it was considered desirable to do so. It is probable that neither the German 16¼-inch, nor the Austrian 12-inch gun was used, for neither of these pieces can cover any such range. More than likely a 12-inch naval piece of the older, short-caliber pattern was used and fired at a high angle of elevation.

**The New Attempt at the Dardanelles.**—The new attempt to break a way through the Dardanelles by a combined sea-and-land attack is more in accordance with the established tactics of such warfare than was the first attempt to batter a way through from the sea. It is possible that the Turkish batteries along the Straits are no better provided with defenses against attack from the land side than are the defenses along the coast of the United States. In that case, if the Allies have sufficient forces available, the forts will be taken in reverse. If the line of forts on the European side be captured, the task of reducing those on the Asiatic side will be greatly simplified.

**American Mechanical Transport.**—The Allies are being supplied by American engineering firms with large quantities of mechanical transport. A considerable portion of this is of the type in which all four wheels are available for traction and braking. The advantages of this type for war conditions are obvious. Not only can these machines operate successfully on broken and yielding ground, but they can take inclines which would be impossible for mechanical transport of the ordinary type with rear-wheel drive and front-wheel steering. These machines have proved to be very serviceable on muddy and broken-down roads such as are encountered in Flanders and in Poland.

**A War of Artillery.**—The present struggle in Europe is a war of artillery; to the side which can produce a preponderance of artillery and an excess of ammunition supplies the victory will belong, other things being equal. Only those who are present on the battlefields of Europe can form any adequate idea of the enormous expenditure of ammunition, and particularly of ammunition for field guns and howitzers, which is taking place. In the House of Commons, the Chancellor of the Exchequer recently stated that during the battle of Neuve Chapelle as much ammunition was expended as was used during the entire Boer war, which latter lasted for two years and nine months. The Neuve Chapelle battle front covered only a few miles, whereas the whole fighting front in all the theaters of the present war must total fully 1,500 miles.

**Radius of German Submarines.**—According to an abstract in an article by a German officer, which appears in *Revista Marittima*, the number of German submarines at the opening of the war was 27, and adding those since completed the number would now be 36 if there had been no losses. New units have been laid down, also, and those building for foreign governments, were, of course, taken over. It is claimed that the water-ballast tanks are filled with oil when the boats start on a long cruise, and the article states that an 800-ton submarine such as "U-47", one of the latest to be put through her trials, cruising at 8 knots on the surface, would use 10 tons of oil fuel for every thousand miles. The boat is credited with a normal supply of 50 tons of oil which would give her a radius of 5,000 miles. If, as the writer suggests, the water-ballast tanks are utilized for oil storage, the radius of action would be even larger.

**Six-inch Guns on Battleships.**—The fact that all the naval engagements between the larger ships have been fought with heavy-caliber guns at the longest ranges at which these guns could be used with effect, has once more brought to the front the perennial question of the secondary batteries of warships. When Sir John Fisher brought out the first dreadnought and the first three battle-cruisers, he left out the secondary armament altogether; and several of the ships which followed them carried nothing heavier than 12-pounders and 4-inch guns in their secondary batteries. In the big engagements of the present war, including the fight off Chile, the 6-inch guns of the armored cruisers for the greater part of the time were out of range, and the 8.2, 12, and 13.5-inch guns settled the fight. Experience had in this war shows that flotillas of torpedo-boat destroyers are the best protection for battleships and battle cruisers against the enemy's destroyers. The substitution of 12-pounders for 100-pounder 6-inch guns would mean a considerable addition to the efficiency of the battleships either in speed, coal endurance, armor or other valuable qualities.

## Science

**The China Medical Board,** recently established by the Rockefeller Foundation for the purpose of improving medical and hospital conditions in China, gives promise of doing incalculable good in a country where, aside from the medical missionaries, there have been heretofore very few representatives of modern medical science. The first task of the board will be to develop medical education in China, and to this end six fellowships have been established to enable Chinese students to take medical courses abroad, in order that they may ultimately teach medicine in their own country.

**The Southern Ocean.**—According to a note in the *Geographical Journal*, this name has been recommended by the British Admiralty and formally adopted by the Commonwealth of Australia and the Union of South Africa to designate the whole oceanic zone encircling the globe south of Australia, Africa, and South America. This name is, of course, not new, but it is not to be found in Lippincott's Gazetteer, and has been used in a merely tentative way by many geographers. As the Admiralty mentions the Antarctic continent as the southern boundary of this body of water, no room is left on the map for an "Antarctic Ocean."

**The Siberian Sea Route.**—Progress in the exploitation of the steamship route to Siberia by way of the Arctic Ocean has been reported from time to time in these columns. The American consul-general at Moscow states that interruption of other trade routes by the war will stimulate the use of the Arctic route, and that extensive preparations are now being made by the Siberian Association for Shipping, Trade and Industry for the shipping season of 1915. Hides, flax, hemp and other raw materials to a value of $500,000 will probably be sent by water to England. The association is building a settlement on the lower Yenisei.

**Sheep-killing Dogs** are said to be the chief cause of the marked decrease in the number of sheep kept on farms in the United States, exclusive of the western division. During the period between 1900 and 1910 the total number of sheep in this region decreased by more than 3,900,000 head in spite of favorable market conditions. The problem of the sheep-killing dog is fully discussed in Farmers' Bulletin 652, just issued by the U. S. Department of Agriculture. In this bulletin it is pointed out that the moral effect upon persons who have witnessed the depredations committed by dogs among sheep is a more serious factor in the situation than the actual damage done. No farmer contemplating the raising of sheep is likely to venture on the enterprise while the flocks of his neighbors are continually meeting reverses through the attacks of dogs. The annual loss from this cause in 36 states is estimated at 107,760 head. Sheep-killing dogs sometimes work singly, but more often in groups of two or three. They do not limit their attacks to the flocks in the immediate vicinity of their homes, but travel for miles in all directions, spreading destruction in the flocks with which they come in contact. Some dogs simply kill one or two sheep in a flock, while others continue the attack until all the sheep are either destroyed or crippled. In many cases sheep are simply chased until they die of exhaustion. Most of the farm states have dog laws, and nominally provide some compensation for the sheep destroyed, but these laws are generally more or less ineffective. Improved legislation and the more general use of dog-proof fencing are suggested as remedies.

**The Dissemination of Chestnut-blight Fungus by Wind** is fully discussed by Messrs. Heald, Gardner and Studhalter in a recent number of the *Journal of Agricultural Research*. This method of dissemination was first suggested by Murrill in 1906, though he probably had only the pycnospores in mind. It has not yet, however, been demonstrated that the pycnospores can be carried on in this way. The studies of Rankin revealed the fact that under moist conditions the ascospores are shot forcibly out into the air, where they can be caught up and carried to considerable distances by the wind. Subsequent investigations showed that vast numbers of the ascospores are thus thrown into the air during summer rains. In order to get more definite information regarding this means of infection, the writers above mentioned carried out observations in a badly diseased chestnut coppice near West Chester, Pa., during the months of August and September. To determine the presence of spores of the chestnut blight in the air at particular times and places a series of exposure plates was made, while the number of spores present was determined by the aspirator method, and other tests were carried out. The general result of these inquiries is stated as follows: "All of the experiments point to air and wind transport of the ascospores of the chestnut-blight fungus as one of the very important methods of dissemination and substantiate the conclusions of Rankin and Anderson. It can now be said with absolute certainty that following each warm rain of any amount ascospores are carried away from diseased trees in large numbers. During dry periods wind dissemination of ascospores does not occur at all or sinks to a very insignificant minimum."

## Aeronautics

**Novel Flying Machine.**—Patent No. 1,133,451 to C. A. Worfel of Grand Rapids, Mich., is for a flying machine having propelling wings which swing and have a limited rotary movement, the parts being so correlated as to secure a turning of the wings on their shafts when at one end of their swing and to turn them reversely at the other end of the swing, the wings being so inclined during the swinging movement as to propel the machine and also to sustain it or cause it to rise.

**Parrots and Aeroplanes.**—In the course of the present European war it has been noticed that parrots work themselves into a state of intense excitement and screech loudly on the approach of an aeroplane, even before the latter is visible to human eyes. A number of these birds were placed on the Eiffel Tower and other suitable points of observation in order to test their utility as sentinels. Unfortunately, however, they are unable to distinguish between friendly and hostile aircraft.

**A Gammeter Flying Machine Patent.**—H. C. Gammeter of Bratenahl, Ohio, has secured patent No. 1,135,009 in which wings arranged at opposite sides of the machine are pivoted about midway between their ends on axes parallel to the line of travel and these wings have their front edges stiffened and their rear edges flexible so there is a propelling action for the full width of both wings on each stroke, the wings being oscillated simultaneously about their respective axes by connection with the driving mechanism of the machine.

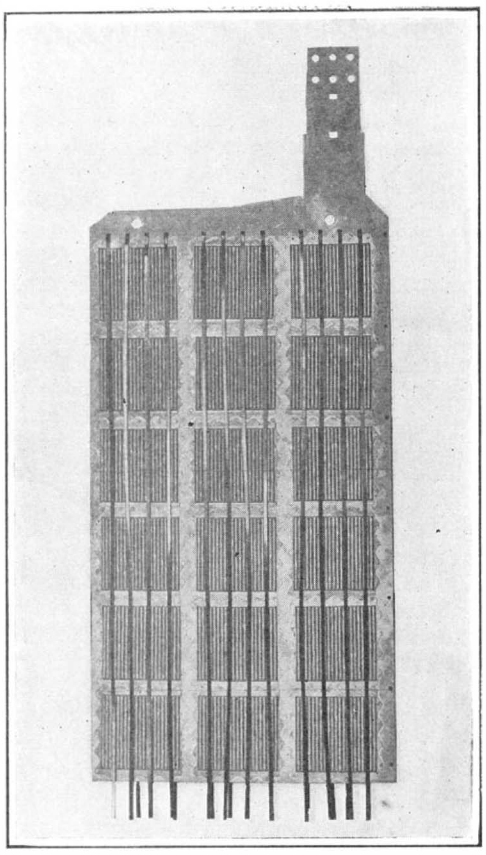
**Life Saving Parachute.**—A life saving parachute has been patented in which a device that may be worn as a garment has a flexible overhanging and relatively wide skirt band secured to the body portion at a point near its upper end and beneath the arms of the wearer and flexible stays are secured to the lower end of the body portion and to the outer edge of the overhanging band so that as the wearer descends his downwardly extending legs will operate upon the stays to hold the band at its outer edges so the latter will expand and operate as a parachute. The patent No. 1,133,924, has been issued to H. C. Brubacker of Sault Ste. Marie, Ontario, Canada.

**Indications of Important Improvements.**—Speaking of the importance of increasing the ranges of speed of aeroplanes a speaker at a recent meeting of the Royal Institution, London, brought out the fact that in 1912 the Cody machine, which won the military prize for that year, had a maximum speed of 72 miles and a minimum of 48 miles—a range of speed of 33 per cent. In 1914 a Sopwith machine had a maximum speed of 92 miles, while its minimum was 37 miles, the range being 60 per cent. In this connection it was noted that altering the shape of the wires on the aeroplane—from round to oval—had brought about a reduction from 10 to 12 per cent in the horse-power required for flying at 70 miles an hour.

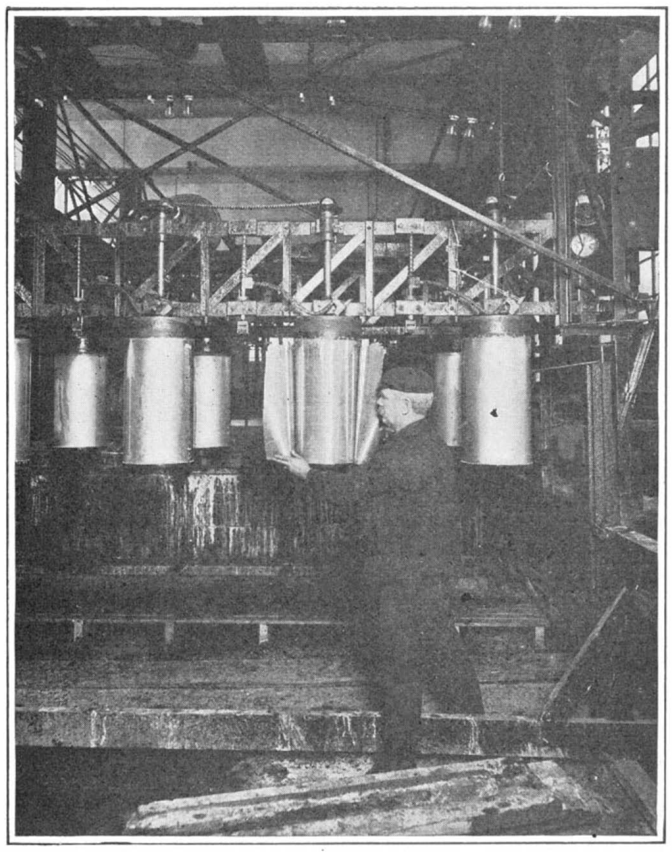
**An Automatic Stabilizer.**—Patent No. 1,133,559 to C. U. Greeley has for an object to provide an aeroplane which shall possess inherent, automatic stability or balance independent of the skill of the operator, and which shall be entirely free from any devices requiring manipulation by the operator for that purpose. In operation the aviator sets the supporting surfaces substantially horizontal, and the propeller draws the aeroplane forward on its wheels. When sufficient speed is attained, the aviator tilts the supporting surfaces backward by means of the controlling screw, and the aeroplane rises bodily and quickly, since all the supporting surfaces are suddenly, rather than gradually, placed in position of their maximum lifting power.

**Firing Between the Propeller Blades.**—It is said to be quite a trick to operate a machine gun from an aeroplane, as must be constantly done from the military aeroplanes in the war region; but it is often desirable to fire directly ahead, which seems impossible with a tractor machine on account of the liability of putting the propeller out of commission. It is reported, however, that a German inventor has devised a scheme for gearing up the trigger of the quick-firer with the engine in such a manner that when a propeller blade is in line with the gun a lock prevents a shot from being fired until the blade has passed out of range. This appears to be a most uncertain operation; but it is stated that R. Garros, the noted French flyer, has a secret method of his own by which he successfully performs the feat.

**Sky Periscopes.**—In the cities of Europe that are liable to be visited by Zeppelin air ships the watchers on the lookout for raiding craft have suffered from stiff necks, and also eye strain from long continued gazing at the heavens to detect hostile aircraft, and to meet this difficulty opticians have devised a special form of sky periscope. This instrument is constructed on the same general principles as those used by submarines, and the type that has been so widely adopted for use in the trenches on land. The device is a simple arrangement of mirrors that the watcher can hold in his hand, and which enables him to scan the entire vault of the sky while looking down in a convenient and natural position. It has been found so convenient that a much better and more constant lookout is maintained.

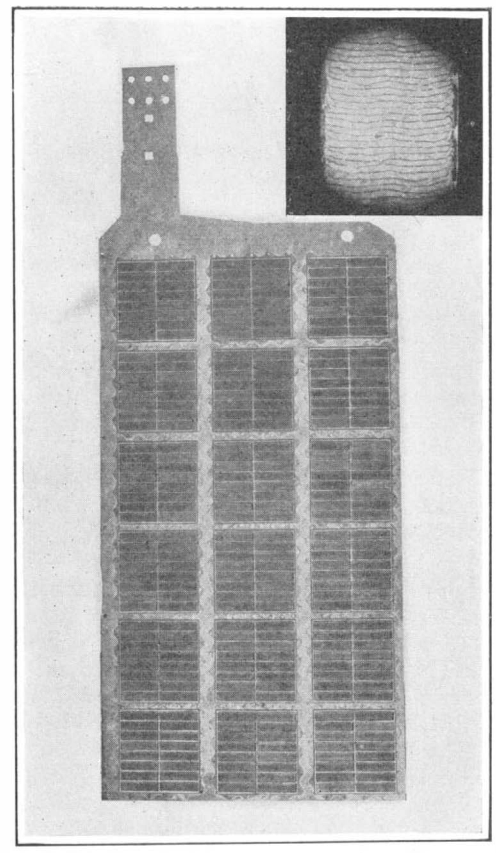


Positive plate containing tubes of flaked nickel. Note spacing strips in front of the plate.



Stripping off the electro deposited sheet 1/64th inch thick. 250 layers of copper and nickel, from which the copper later is dissolved.

Positive tube.



Negative plate; also magnified sectional view of a loaded tube.

**Edison submarine boat storage battery.**

## Marconi's Wireless Telephone

**By J. Andrew White**

A FLEET of war vessels going into action with the admiral transmitting orders to his captains by word of mouth is the latest wonder promised in wireless communication. Following many rumors that a practicable wireless telephone was being quietly developed by Marconi, definite announcement has just been made that the Italian Navy has adopted the instrument and the British Admiralty has been conducting tests aboard English vessels. One instrument has already arrived in this country and communication has been established between New York and Philadelphia.

How great will be the distances spanned is not yet definitely stated, but it is reported that Marconi has expressed confidence in his ability to transmit audible speech across the Atlantic by multiplying the power and modifying the design of the present apparatus. It is possible that this feat may be accomplished when foreign conditions are again adjusted to normal. It would not be, as generally reported, wholly a scientific demonstration, for recent developments have given to transatlantic wireless telephony apparatus that would make it commercially practicable under ordinary business conditions. The short distance wireless telephone, however, will not wait for the end of the war. It is expected to become available for commercial use within a few months and will have a guaranteed range of at least thirty miles between ships at sea carrying aerials 100 feet high and with 200-foot span between masts.

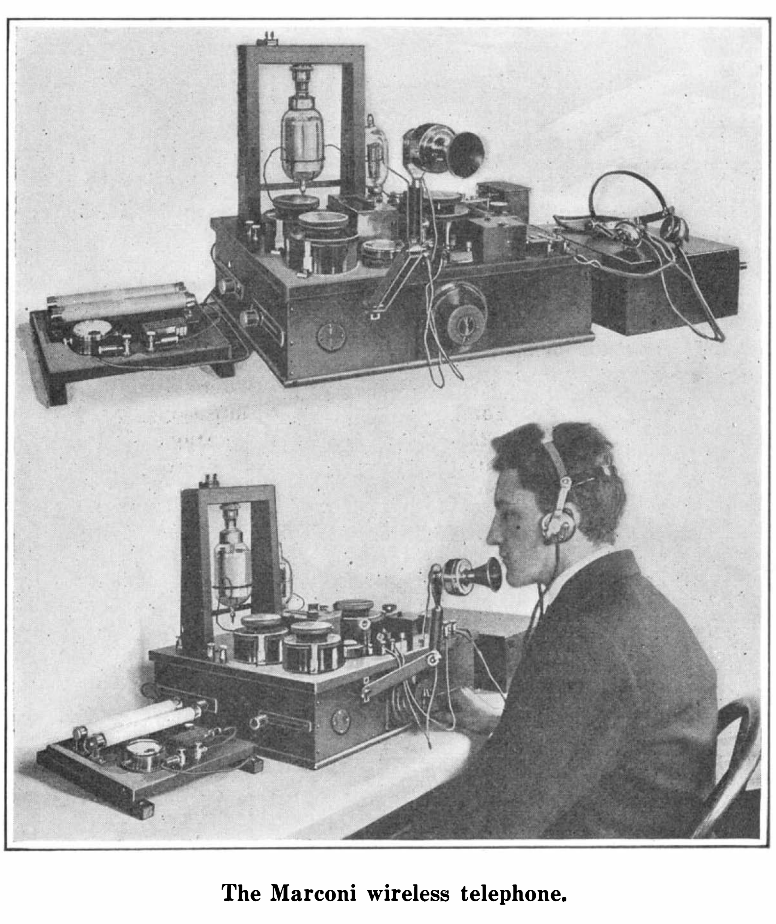
Unlike the wire telephone with its slight diaphragm distortions of the voice, the wireless instrument reproduces remarkably clear speech, and, if preferred, speech of equal quality but considerably stronger than that obtained with the wire telephone.

The wireless transmitter consists of a specially constructed valve which controls the current and is shunted with condensers and self-induction coils so as to produce a continuous stream of oscillations. The frequency of these oscillations is controlled through the variable ebonite condensers, shown in the illustration in front of the transmitting valve. The oscillations of wave energy produced by the valve being continuous, of high frequency and of constant amplitude, no sound is heard in the receiver, even if the latter is placed but a hundred yards away.

The variation required to transmit the tones of speech is secured by means of a microphone or sound magnifier, a method of connection with which permits this instrument and the receiving telephone to be placed in the captain's quarters or chart room while the apparatus itself remains in the wireless cabin. The change-over switch may also be controlled from a distance and with one operation it switches the instrument from talking to listening position.

An 80-ampere hour accumulator is provided for the low voltage current used to heat the filaments of the valves and four cases of dry cells connected in series give the high tension 500-volt current necessary for the vacuum of the transmitting valve. The usual value of the vacuum current being from 10 to 20 milliamperes it is sufficiently small to make practical the use of dry cells for intermittent purposes.

Through tuning, as in wireless telegraphy, it is possible to select the particular receiving station wanted, and adjusting to the series of waves emitted, exclude all other stations which happen to be sending within the range of influence at the same time.



The Marconi wireless telephone.

## Edison Submarine Boat Storage Battery

**By Herbert T. Wade**

THE extensive use of submarines in naval warfare has directed attention to their weakness as well as their strength and usefulness, emphasized perhaps by the recent and tragic disabling of the United States submarine "F-4" in Honolulu harbor, with the loss of its crew. A submarine, when operating below the surface, naturally cannot make use of a gasoline internal combustion motor to drive its propellers, but employs electricity from a storage battery; therefore, any improvements working for increased power and efficiency in the storage battery must act to the advantage and safety of the submarine, increasing both the facility of its operation and its radius of under-water action from its present limits of about 100 miles by some 50 per cent and reducing materially the danger of asphyxiation of the crew. In a submarine, economy of weight and space, contamination of breathing air, the necessity for ventilation, care of the cells, and the durability are peculiar and special considerations. Until quite recently, the type of accumulator employed was the familiar lead-sulphuric acid storage battery with tandem plate, open-jar construction, with hard rubber cells, housed in a lead-lined battery tank. With such an arrangement not infrequently the electrolyte would be spilled, and so care is exercised to prevent the angle of diving from running much over 15 degrees, and to maintain as level a keel as possible to avoid spilling the acid, for should there be a break in the lead tank, the sulphuric acid would straightway attack the steel plates of adjoining ballast or fuel tanks or bulkheads. Furthermore, in the presence of sulphuric acid, seawater is decomposed and chlorine gas with its dangerous fumes is produced; while the acid attacking the gasoline fuel tanks, naturally may lead to the escape of gasoline. Both the chlorine fumes and gasoline vapor are not only disagreeable, but positively dangerous. Thus on the United States submarine "E-2" in the autumn of 1914 while at sea on her way from Newport News to New York, the escaping chlorine fumes seriously affected the crew despite prompt measures for their relief. About the same time, when the battery tank of one of the D submarines was inspected, it was found to contain gasoline in substantial and dangerous amounts as a result of the fuel tanks being eaten away by acid. Consequently, the elimination of lead-sulphuric acid storage cells on a submarine, and their replacement by a battery, where the electrolyte does not attack, but actually preserves steel, and where the electrolyte can be mixed with seawater without dangerous effect, is naturally a distinct advance and advantage.

The fundamental principle of the Edison storage battery as now being installed on a United States submarine, in which these advantages are realized, is the oxidation and reduction of metals in an electrolyte which does not dissolve the metals and will not combine either with them or their oxides. This electrolyte when decomposed by the action of the battery is immediately reformed in equal quantity, and unlike the sulphuric acid solution, is, therefore, practically constant, without change of density or conductivity over long periods of time. The active elements of the battery are nickel and iron, employed not in the form of metal, but as nickel hydrate and iron oxide, carried in perforated pockets or tubes. The electrolyte is a 21 per cent solution of potassium hydrate, with a small amount of lithium hydrate added. As only a small quantity of the electrolyte is necessary, this permits a very close proximity of the plates.

Where the Edison storage battery exhibits special adaptability and advantage for use on submarines is in saving weight; being much lighter than other batteries of equal capacity, so that this difference can be applied to pig-

(*Concluded on page 461.*)

# What Is Matter Made Of?

## Resemblance of the Atom Structure to an Infinitely Small Solar System

By Arthur H. Compton

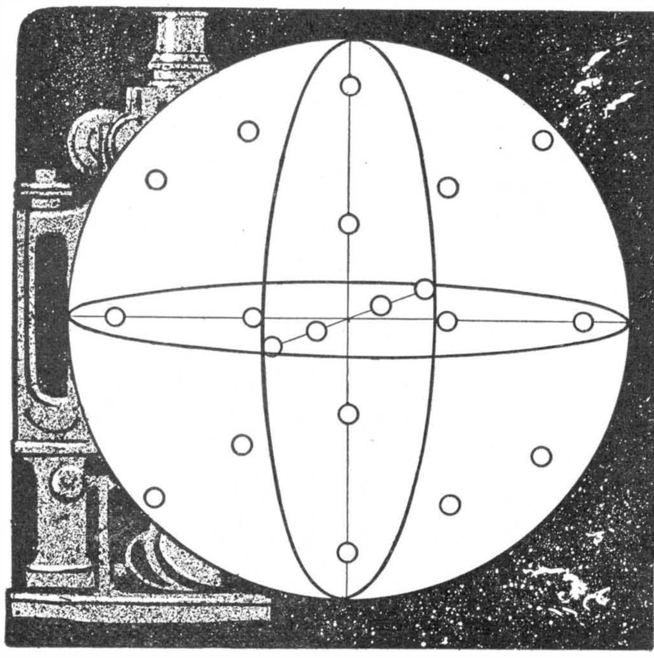


Fig. 1.—Diagram illustrating Lord Kelvin's theory of electrons.

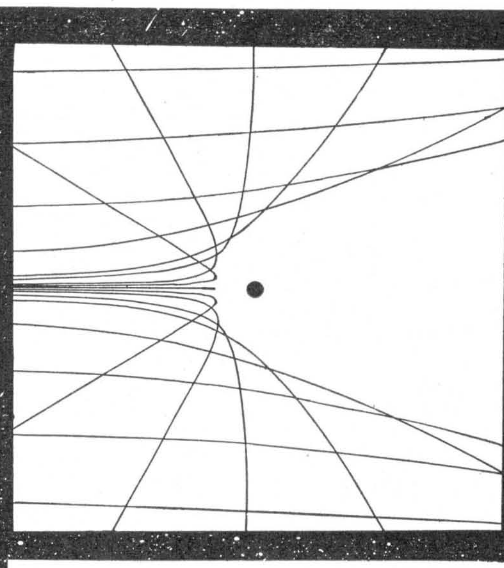


Fig. 2.—Paths of alpha particles in relation to a positive nucleus.

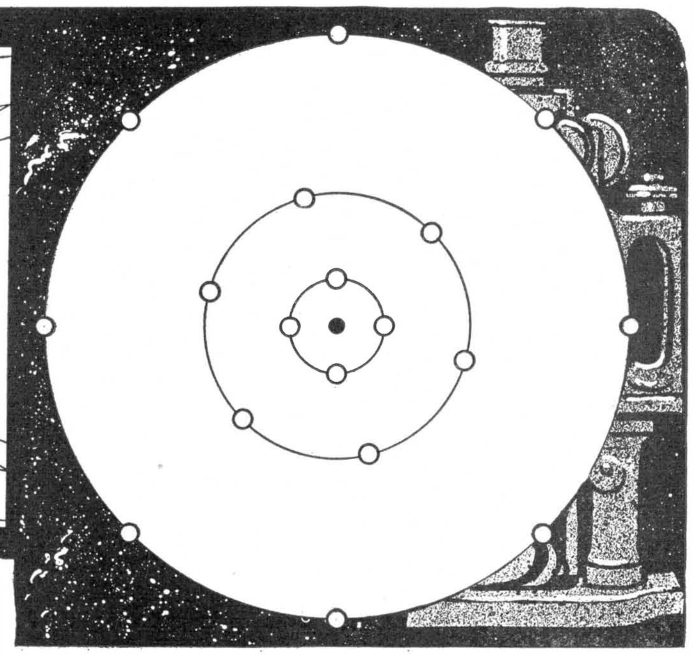


Fig. 3.—Diagram illustrating Prof. Rutherford's idea of an atom.

BY the general acceptance of the molecular theory of matter and of the combination of atoms into molecules the scientists of the last century made a long step toward the solution of that greatest of physical problems, the constitution of matter. It has remained for the scientists of the present century to probe still deeper and investigate the structure of the atom itself. For a long time the atom was considered to be the ultimate unit of matter. Not until the demonstration of the existence of the electron, at the dawn of the present century, was matter suspected of being still further divisible. The discovery, however, of a particle one eighteen hundredth the mass of a hydrogen atom, showed that not even the atom could be a unit, but must be a system of some sort. Ever since this discovery it has been recognized that the atom must be explained in terms of electricity. The problem has been to devise a model, made up of electrons and sufficient positive electricity, which will have the properties an atom is known to possess.

The construction of such a model atom is complicated by the fact that, though a natural unit of negative electricity is known in the electron, no corresponding unit of positive electricity has ever been found. It is true that very small positively charged particles are known, such as the alpha particles which are given off by radium, and the positively charged particles in "canal rays," but these, instead of carrying a charge equal to an electronic unit, carry, in general, some multiple of that charge. It is this positive charge in the atom that has been hardest to explain, and about which the discussion has chiefly centered.

There have been a large number of explanations offered, but the first of value was that of Lord Kelvin. His idea was that the positive electricity is uniformly distributed throughout a sphere whose radius is the radius of the atom. The electrons move about within this sphere under the attraction of the positive electricity and the repulsion of the other electrons, as in Fig. 1. This model is particularly interesting because the attraction of the electrons toward the center of the sphere varies directly as their distance from the center, just as the weight of a body within the earth's crust is proportional to its distance from the center of the earth. It was on account of the simplicity of the mathematical representation of an atom with this law of force that Lord Kelvin suggested such a model. He did not intend it to represent the actual structure of the atom, so we are not surprised to find that recent experiments show this model to be impossible.

The other most important model of an atom has been suggested by Prof. Sir Ernest Rutherford. He imagines an atom to be built up like a solar system on an extremely small scale (Fig. 3). The positive electricity is concentrated into a very small nucleus, which takes the place of the sun, and the negative electrons revolve about this like planets. It seems probable that they are arranged in rings, like the rings of Saturn. The extreme simplicity of such a model is a strong point in its favor if it will work. At a lecture before the Physics Colloquium at Princeton, Prof. Rutherford gave an interesting summary of recent experiments which have given evidence as to the structure of the atom. These experiments have not only supported his theory, but they have enabled him to count the number of electrons in the atoms of the different elements and to tell some of the properties of the positive nucleus.

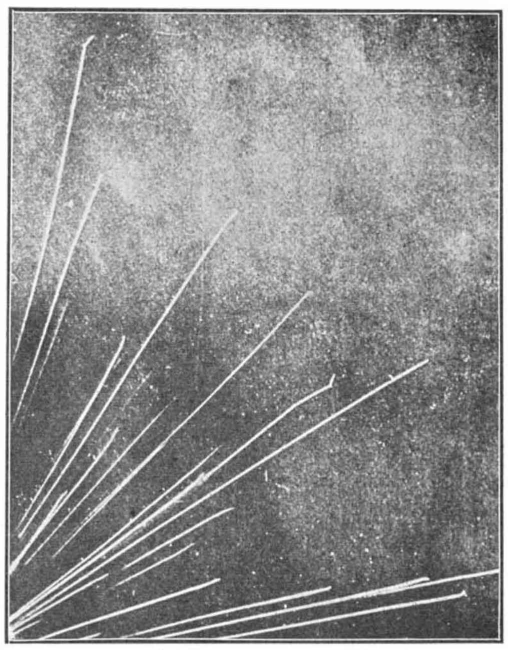


Fig. 4.—Paths of alpha particles through watery vapor.

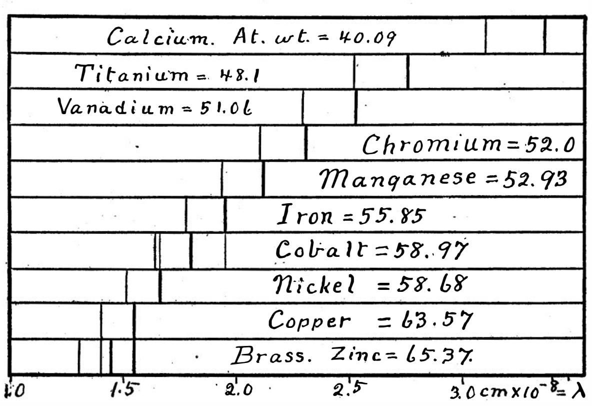



Fig. 5.—X-ray spectra of ten metals, according to Moseley.

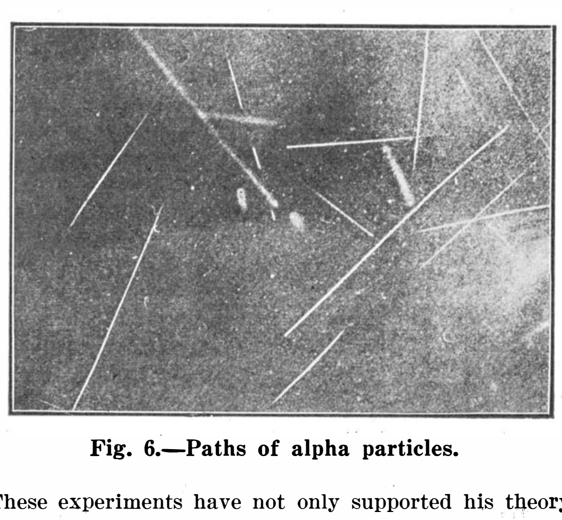


Fig. 6.—Paths of alpha particles.

Possibly the most striking confirmation of his theory of the atom comes from the passage of alpha particles through matter. Alpha particles are the positively charged corpuscles shot off with extremely high velocity by radio-active substances. They are given off with a certain definite velocity, about a fifteenth that of light, and will travel through a definite thickness of gas, or even through a thin piece of solid matter. Fig. 4 shows some remarkable photographs obtained by Prof. C. T. R. Wilson, showing the paths of these particles through water vapor. It may be seen that as they pass through the vapor the greater part of their path is straight. It can easily be shown, however, that during this motion the particle must pass through myriads of atoms. Now an alpha particle is known to unite with two electrons to form a helium atom; it is, in other words, a helium atom with a double positive charge. So if we consider the atom to be continuous spheres of definite diameter, as these positively charged helium atoms pass through the atoms of vapor we have the extremely interesting phenomenon of two different bodies occupying the same space at the same time. In order to account for the fact that these particles pass through such long distances without being moved from their path by collisions it is necessary to conclude that both the alpha particles themselves and the centers with which they collide shall be very small—much smaller than the atom itself. We are therefore limited to the idea that the charge must be concentrated on a very small nucleus. Let us see what we can find out about the properties of this nucleus.

In order to place an upper limit upon its diameter an experiment was tried to see how close the alpha particles could come to the centers of collision in the atoms. When these particles are discharged onto a solid surface most of them are absorbed, but a small proportion are reflected from the surface, some of them straight back from the way they came. It is as though a gunner were shooting at a target until it was riddled with holes, when suddenly a bullet would bounce back at him with almost its original velocity. The gunner would probably be surprised enough to hunt the reason for this unusual event. It is none the less surprising that these little particles should rebound, for these projectiles strike the target at ten thousand miles instead of a few thousand feet per second, and only one in thousands is reflected back on its course. There must be some powerful force acting which will cause such a sudden change in velocity.

This force is found to be none other than the electric repulsion between the positively charged alpha particles and the positive nucleus of the atom. As in Fig. 2, if the particle passes at a noticeable distance from the nucleus, its course is not changed because of its high velocity, but if it comes very near, it is deflected away in a hyperbolic curve. By measuring the number of alpha particles which are scattered at different angles by different substances, it is possible to calculate both the forces acting and the distances between the two positive charges when they are closest together. It is found that if each nucleus is given a mass of an ounce, on this scale their centers would come closer than half a thousandth of an inch of each other, and the electric

repulsion between the two particles would be in tons one with thirty-four ciphers after it. No wonder the particles fly away from each other with such terrific speed after a collision! The forces acting indicate that there is a positive charge on the nucleus of the atom equal to about one half the atomic weight, measured in electronic units. Thus the heavy elements have a greater charge on their positive nuclei than have the light ones. But possibly a still more interesting deduction is that in an extreme case, when the nuclei of two hydrogen atoms collide, the distance between their centers is considerably less than the diameter of an electron. We must conclude, therefore, that the nucleus of the hydrogen atom, though much heavier, is considerably smaller than an electron.

Let us consider the charge on the nucleus from another standpoint. In a recent article in the SCIENTIFIC AMERICAN SUPPLEMENT I described some remarkable photographs taken by Mr. H. G. J. Moseley, showing the X-ray spectra of a number of different elements. Fig. 5 shows the spectra of the rays given off by some of these elements when used as the target of an X-ray bulb. The most striking thing about these photographs is the remarkable similarity of the spectra of the different elements. It will be seen that the wave-length of the rays increases uniformly as we pass from the heavier to the lighter elements. This, of course, corresponds to a decrease in the frequency of vibration. In fact, Mr. Moseley showed that the square root of the frequency corresponding to the more prominent line in these spectra changes by a constant difference as we pass from element to element in the order of their atomic weights. It is the inner ring of electrons in an atom, such as shown in Fig. 3, whose vibrations cause the lines shown in these spectra. The greater the charge on the nucleus the more firmly are the electrons held in their orbits, so that they naturally vibrate with greater rapidity. So this regular increase in frequency is easily explained if we consider the atomic nucleus of each element to carry a greater electric charge than the nucleus of the element next lighter, which is in accord with what we found by the scattering of alpha particles. By a little calculation it is easy to show that, in order to account for the shift in these spectral lines, the charge on the nucleus must change by one electronic unit as we go from one element to the next. There are a good many reasons for believing that the charge on the nucleus of a hydrogen atom is one, so that the charge on the positive nucleus of any element is $Ne$, where $N$ is the number of the element in the order of atomic weights counting hydrogen as one, helium as two, etc., and $e$ is the electronic unit of electricity. For the electrically neutral atom this of course means that there are $N$ electrons revolving about the nucleus. Thus, if zinc is the thirtieth element, the charge on its nucleus is $30e$, and there are thirty electrons revolving about the nucleus in orbits. This is in good agreement with what we found by the scattering of alpha particles, that the charge on the nucleus is equal to about half the atomic weight of the element, for the atomic weight of zinc is 65, which would make the charge on its nucleus about $32e$.

The determination of the mass of the nucleus presents no difficulty. The mass of the whole atom is well known, as is also that of the $N$ electrons which are revolving about its nucleus, so that of the nucleus is simply the difference between the two. The mass of the electron is so small, however, that the nucleus may be taken to possess the whole mass of the atom without sensible error.

The accurate estimation of the size of the nucleus carries with it an explanation of the mass of the atom. If we take the hydrogen atom as the simplest example, the charge on the nucleus is $+e$. So, in order that it shall be electrically neutral, the atom must contain one electron. The mass of the electron is, however, electrical in nature. That is, when it moves it acts like an electric current whose self-induction gives it a kind of inertia. By making the wire which carries a current fine enough it can be given any desired amount of self-induction, and similarly, if a charged particle is made sufficiently small, it can be given any desired amount of electric inertia or mass. But it seems very improbable that the mass of the atom should be of two kinds, partly electrical and partly of some different, unknown nature. So as we know that at least a part of its mass is electrical, it seems only reasonable to explain the rest in the same way. In order to do this it is only necessary to assign to the hydrogen nucleus a diameter of one eighteen-hundredth that of the electron, and on account of the extreme minuteness of the nucleus as shown by collisions with alpha particles, this does not seem improbable. It is easy to see how the nuclei of heavier atoms might be made up of a group of these hydrogen nuclei, and still act as point charges when battered by alpha particles. In this way the mass of all matter is explained as due to the well understood phenomenon of electro-magnetic induction.

We have thus not only determined the charge on the nucleus of the atom, but from a knowledge of its mass we have estimated its size as well. For a hydrogen atom these quantities are approximately:

Charge on nucleus $= e = 4.7 \times 10^{-10}$ e. s. units,
Mass of nucleus $= 1.6 \times 10^{-24}$ grammes,
Radius of nucleus $= 1.0 \times 10^{-16}$ centimeters.

Knowing the size and mass of the nucleus, we find its density to be $3.8 \times 10^{23}$, which is inconceivably greater than that of the heaviest element. In order to form an idea of what these figures mean, let us construct a model of an oxygen atom on a large scale, considering its nucleus to weigh a ton. As its atomic weight is sixteen, we may expect its nucleus to contain sixteen hydrogen nuclei. These will be represented by positively charged particles, each weighing over a hundred pounds, but so small as to look like the finest dust. Since oxygen is the eighth element in the order of atomic weights, its nucleus will have a positive charge of eight, so the nucleus will contain also eight electrons, which will neutralize half of the sixteen positive charges. These electrons will be represented by grains of fine sand, each weighing an ounce, and the whole nucleus will be a very small fraction of an inch in diameter. Of the eight electrons revolving about the nucleus, the inner ring will be similar grains of sand traveling with tremendous speed at a distance of a few inches, while the outer ring will be at a distance of several feet. The nucleus of the other atom of the oxygen molecule will be a yard away, and the next molecule of the gas will be about a rod off. Looking at it in another way, if a hydrogen nucleus were as large as the sun, the nucleus of the next atom would be at the distance of one of the nearer fixed stars.

Besides giving us a great deal of definite information as to the structure of the atom, these investigations have opened up new lines for study. What is the force

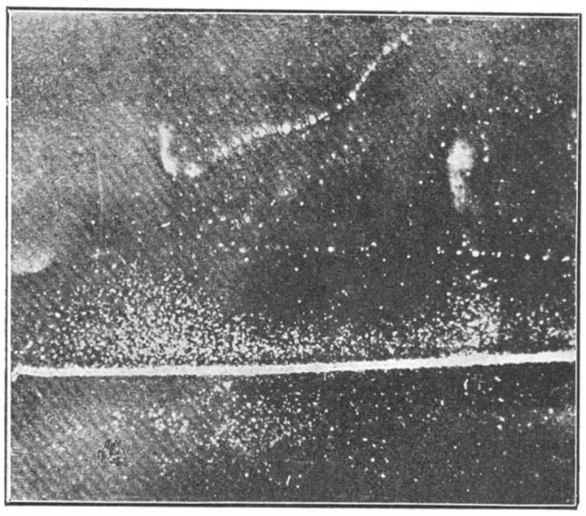


**Fig. 7.—Path of an alpha particle.**

which binds together the different parts of the nuclei of the heavy atoms? Is it not possible that the tremendous energy of a radioactive discharge may be explained as due to the instability of this force in complicated atoms? What arrangement of the electrons about the nucleus will explain the physical and chemical properties of the atom as we know them? Questions such as these we may expect to have answered in the near future now that we have a definite idea as to the general structure of the atom.

## Chlorine Gas on the Battlefield

IN the evolution of warfare there has been continuously an increasing use of forces farther and farther from the direct use of muscular power. This is the same line of progress as that shown in industrial development. An increased use of machines, the applications of physical forces as they become known through scientific study and in general the gradual substitution of natural forces controlled by mind for the muscular exertion of earlier times.

Many of the operations of war are the same in their essence as those of peace; the organization of transportation, the supplying of food and water, transmission of intelligence by all sorts of methods, the application of sanitation and medical service and many other activities of war are similar to those of peace and they call upon all available knowledge of mechanics, physics, chemistry and bacteriology.

The methods of destruction also call upon knowledge from most of the arts and sciences, and each step in their evolution is a further application of scientific knowledge.

In the present European war the application of such knowledge seems to be reaching the utmost limit of ingenuity. It may almost be called a chemist and physicist war with its application of physics in aerial navigation and its use of submarines, of telephones, wireless telegraphy, searchlights, and range-finders, and the application of chemistry in the manufacture of its many explosives, the manufacture of hydrogen for airship, its illuminating bombs and flares and latest of all in the manufacture of poisonous gases to be used for tactical purposes.

The reports which have been received seem to show that the gas so far used is chlorine. The greenish yellow color, the strong smell, the great density of the gas causing it to flow along the ground are indications of chlorine. The symptoms shown by its victims are those exhibited by persons who have been poisoned by chlorine in industrial accidents; that is great irritation of the mucous membranes, bronchitis, and sudden death by a narcotic action in the most severe cases.

If chlorine is the gas which was used, it must have reached the trenches in a concentrated form to cause death unless the death was due in part to psychological effects, for to produce death rapidly it is necessary that the air breathed shall contain at least one part of chlorine in 1,000 of air. Long exposure to air containing 1 part of chlorine per 100,000 is dangerous and even smaller amounts are troublesome.

It is of some interest to know how much chlorine is needed to be effective. On the supposition that there is a breeze of 4 miles per hour and that it takes two minutes to empty the containers holding the chlorine, the drift of air during that time would be about 700 feet, to charge the lower three feet of this air current with chlorine to a concentration of 1 to 1,000 would require about 6 cubic feet, or one pound for each yard, or something like one ton per mile of battle front. Chlorine can be obtained commercially compressed into liquid form in cylinders for 5 to 8 cents a pound, and as a by-product in the electrolytic manufacture of hydrogen for balloons it may well be of less value.

Under proper conditions then it is quite feasible to use this inexpensive and powerful offensive weapon. But the conditions must be right. Too strong a breeze would diffuse the gas, a variable wind or calm would injure the user. It would hardly be safe to use the gas unless the battle line were straight or convex toward the enemy since otherwise the fumes would be apt to drift in part over the users' own lines.

And then undoubtedly effective preventive or antidotal measures can be used. A sponge or towel wet with water or better with some basic substance like cooking soda or borax kept ready to put over the face might hold off the danger and more special respirators charged with basic substances or with reducing agents like oxalates or sodium hyposulphite might enable the attacked force to tide over the worst of the attack.

There are several other poisonous gases besides chlorine which might be used, of which the following may be mentioned: hydrocyanic acid, sulphur dioxide, arsine, carbon disulphide, hydrogen sulphide, the oxides of nitrogen and bromine vapor. From the field of organic chemistry could be taken the cacodyl compounds and the isocyanides.

Since several of these do not act at once they are probably not suitable as the effect to be produced is not so much actual poisoning as the forcing of an opening for an attack in the ordinary way. Some of them are too light to flow readily along the ground and are less suitable.

Probably sulphur dioxide and bromine might be used in a similar way to chlorine as they are extremely irritating, act at once, and are heavy. But they could both be absorbed by respirators similar to those effective for chlorine. Sulphur dioxide is colorless, and on that account not to be detected by the eye, but it is not as dangerous as either chlorine or bromine.

While the use of poisonous gases has been spoken of as in the line of evolution of warfare, since it is an application of advanced knowledge, the thought comes that in view of the apparent cruelty involved it can be used only when it is shown to be of great military value. It has been apparently of some military value temporarily, and is used against military forces and not against non-combatants and in that sense is perhaps more allowable than the dropping of bombs in cities or the bombardment of undefended towns, but the weapons which seem most in line with this use of gases in war are the saw-toothed knife, the jagged spear, and the dum-dum bullet. With the perfection of preventive measures the tactical advantages may be removed and this barbarous application of scientific knowledge may not tempt the leaders of armies of so-called enlightened nations.

**Cannibalism Among Foxes.**—The cannibalistic tendencies of foxes have proved a serious drawback to the valuable fox-raising industry of Prince Edward Island, according to a recent consular report. Not only are the pups frequently eaten by their parents, but females are sometimes killed and partially eaten by their mates. As the adult animals may be worth several thousand dollars a pair, this is a serious matter. A remedy is found in the filing down of the canine and bicuspid teeth of the male fox; this gives the female such an advantage in a fight as to insure her safety, and also minimizes the danger of the teeth of the parent fox being caught in the skin of the pups when playing with them, giving him a taste of blood which tends to make him want more.

## Lessons of the Present War From a Technical Point of View

**By Hudson Maxim**

THE main lesson of the present war is the importance of insurance against war by scientific preparedness, especially preparedness with the machinery of war, and preparedness with men trained to the use of that machinery. This is an age of machinery, where hand-labor is largely replaced by labor-saving mechanism. Labor-saving machinery applies to the work of war in just as large measure as it does to peaceful industries.

The lesson second in importance is that, after war comes upon a nation, there is no time to equip for the fray, and even if there were time it is not the right time, for the tremendous extravagance of preparing for war under the pressure of war is amazing.

Not one of the Allies in the present war was adequately prepared for the war. By consequence, it is necessary for them to pay most extravagant prices for all kinds of munitions of war. Had England, France, or Russia spent one quarter of what this extravagance has cost them during the present war, in preparedness before the war, there would have been no war, and even had war come they would have been able to carry on the war without this great extravagance, and northern France and Belgium would not to-day be within the German lines.

Even had little Belgium prepared herself for this war as adequately as Switzerland keeps herself constantly prepared, she would have been able not only to retard the march of the Germans, but also to have held them back until support came from her allies.

England and France had pledged themselves to stand by Belgium. They should have been adequately prepared to defend that pledge by force of arms.

The lesson of the war next in importance is the fragility of treaties. Of course, all history has taught this lesson. It is a lesson that has been repeated in every generation. But it has been given such impress upon the minds of men of this generation that it is not likely again to be forgotten for the next century. The fact is, and all history supports the conclusion, that nations know no law but necessity, and can be made to obey no law except necessity, in time of war. The only way that international treaties can be made binding is for the majority of the nations of the world to sign them, and pledge themselves unitedly to support them and enforce them. Then no one nation would dare to break a treaty, because by so doing she would bring a world in arms against her. She would, even then, be governed by her supreme necessity, because the necessity of observing the treaty would be greater than any other necessity.

I have treated upon the lessons of the present war at considerable length in my recent book, "Defenseless America," to which I respectfully refer the reader. Within the limits of the present article I can merely touch upon the main points.

The next important lesson of the war is the unreliability of all prophecies of the pacifists who have told us for the past quarter of a century that human nature had so much improved in recent years, and international brotherhood had become so dominant, and civilization of such a high order had arrived, that the nations were not going to war much more.

We all well remember the famous book of M. de Bloch, published near the close of the last century, in which he predicted that the last great war of the world had been fought; that war with modern enginery would be suicide to the countries engaged. It was this book that led the Czar of Russia to call the first Hague Conference to consider the disarmament of the nations.

Since the publication of M. de Bloch's book there have been the English-Boer war, our war with Spain, the revolution in China, the Russo-Japanese war, the Italian-Tripoli war, two Balkan wars, a continuous guerrilla warfare in Mexico, and now we have the great European conflict. Surely, there has not been much shortage in wars.

Even a few months before the present war broke out, Dr. David Starr Jordan made the following announcement in his book, "War and Waste":

"What shall we say of the great war of Europe, ever threatening, ever impending, and which never comes? We shall say that it will never come. Humanly speaking, it is impossible.

"Not in the physical sense, of course, for with weak, reckless, and godless men nothing evil is impossible. It may be, of course, that some half-crazed archduke or some harassed minister of state shall half-knowing give the signal for Europe's conflagration. In fact, the agreed signal has been given more than once within the last few months. The tinder is well dried and laid in such a way as to make the worst of this catastrophe. All Europe cherishes is ready for the burning. Yet Europe recoils and will recoil even in the dread stress of spoil-division of the Balkan war. . . .

"But accident aside, the Triple Entente lined up against the Triple Alliance, we shall expect no war. . . .

"The bankers will not find the money for such a fight, the industries of Europe will not maintain it, the statesmen cannot. So whatever the bluster or apparent provocation, it comes to the same thing at the end. There will be no general war until the masters direct the fighters to fight. The masters have much to gain, but vastly more to lose, and their signal will not be given."

This is a strange prophecy in view of what immediately followed it. Verily, "Who is this that darkeneth counsel by words without knowledge?" (Job, xxxviii, 2.)

There is one other important lesson which I will mention before closing, and it is, that nothing like as many men are killed in the present war as was predicted. This war does not mean international suicide, and the expense does not mean international bankruptcy.

The total number of inhabitants of the countries engaged is about 500,000,000, without counting more than a small part of the great population of India, and the total number killed and wounded during the present war, even if put at 800,000, would be 1,000,000 a year less than the birth rate, while the total number killed, if taken at 800,000, would be less than one sixth of the birth rate. Even if we put the cost of the war at the high amount of $15,000,000,000 for one year, it would be only 5 per cent of the warring nations, because their wealth is about $300,000,000,000. As most of the money is expended by the nations within their own frontiers—in other words, spent at home—the actual out-of-pocket loss is nothing like $15,000,000,000, or 5 per cent.

If the present war should by any possibility end in a draw, it is very likely that each of the warring nations would be stronger in men and means at the end of the war than they were at the beginning. Spain greatly benefited by her war with us; we benefited greatly by our war with Spain. The Boers of South Africa have much to thank England for, for her victory over them, while England is better for the fight. Japan was greatly vitalized and benefited by her war with Russia, and Russia was even more benefited than was Japan.

At the end of the first Balkan war we were told that Serbia was utterly exhausted, yet she was able to beat Bulgaria in a most desperate war. Again we were told that she was utterly at the end of her men and resources; consequently, when she was invaded by Austria in the present war, and the invaders were driven out with great discomfiture, it came to us as a surprise.

While we may rightly deplore war, we must recognize and admit its advantages as well as its disadvantages; otherwise we wrong ourselves by deceiving ourselves.

If we were to admit, with the ultra-pacifists, that there was never a good war nor a bad peace; that all wars are bad and injurious; that every war since the beginning of time has been a calamity, then we have all the more reason for adequate preparedness against so dread an eventuality; and we know, if we know anything in this world, that there is only one way to prepare against war, and it is with guns and trained men behind the guns.

## The Current Supplement

IN the current SUPPLEMENT of the SCIENTIFIC AMERICAN, No. 2054, for May 15th, 1915, there is an illustrated description of an Exposition of Military Sanitation in Berlin, which tells many interesting things about the methods followed by the Germans in handling and treating the wounded in the present war. Another interesting illustrated article gives facts in relation to the culture of hemp in this country. The extremely valuable paper on The Submarine in Naval Warfare is concluded, and contains several appropriate illustrations. The Pathology of Mental Disorders is dealt with in copious abstracts from a very comprehensive paper on this important subject. Another article of general interest tells many things about commercial glucose and its uses. This is a material that is of wide interest, entering as largely as it does into many food products, and one that is generally misunderstood. Salts colored by cathode rays discusses an interesting phenomenon and offers some explanation. Mutations and Modifications of Bacteria treats of a subject that is of importance in regard to the proper recognition of species and kinds, and their derivation from one another. There is a story telling about the production of a new food from dried beer yeast in Germany; a short discussion of what electrical engineering has done for human progress and efficiency; and last, but not least, there is another of the series of lectures on Atoms and Ions, by Sir J. J. Thomson.

---

**Proposed Zoological Survey of India.**—At the suggestion of the trustees of the India Museum, the government of India contemplates establishing a Zoological Survey analogous to the existing Botanical and Geological Surveys of that country, and based upon the existing zoological and anthropological section of the museum.

# Correspondence

*[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]*

## Mr. Edison on the Edison Fire

To the Editor of the SCIENTIFIC AMERICAN:

The Detroit Brick Manufacturers' and Dealers' Association is distributing throughout the United States a pamphlet entitled, "The Edison Fire."

The results of the fire at my plant on December 9th, 1914, were these: Of the seven reinforced concrete buildings none were destroyed. A small section of the upper floor of one of the buildings fell in, but was supported by the lower floors. The pamphlet referred to presents three views of this, the suggestion being that they were of three different buildings. The brick administration building to which they refer, which remains standing, was protected by an adjacent concrete building and was not subjected to the fire.

Every brick and steel building which was attacked by the fire was completely destroyed, together with all the machinery they contained, while the damage done to concrete buildings amounted to about 12½ per cent, and of the machinery contained in the concrete buildings 98 per cent was saved and is now in operation. Manufacturing was resumed in some of the old concrete buildings within a few weeks after the date of the fire.

Temperatures were far in excess of those in the ordinary fire, but reinforced concrete showed its superiority over any other fire resisting material.

The millions of dollars of fire losses in this country annually make it a matter of moment that the superiority of reinforced concrete for fireproof structures should be thoroughly understood, and it is for such purpose that I have written this letter. THOS. A. EDISON.

Orange, N. J.

## Vacuum Gasoline Feed for Automobiles

To the Editor of the SCIENTIFIC AMERICAN:

Permit me to point out an error in your issue of April 24th, which occurred on page 386. You say, speaking of the vacuum gasoline feed system for automobiles, "at this angle no pressure system could possibly force gasoline to the carbureter."

Gasoline is, roughly, one half as heavy as water or four feet head for every pound of pressure. The usual pressure system maintains two pounds, but a readily made adjustment will cause them to maintain three or four. This means eight, twelve, and sixteen feet, respectively. The case illustrated is not raised above six or seven feet. E. PAUL DU PONT.

Montchanin, Del.

## Defenselessness of the United States

To the Editor of the SCIENTIFIC AMERICAN:

I desire to express my hearty approval and appreciation of the most timely and instructive series of articles regarding the defenselessness of the United States now appearing in the SCIENTIFIC AMERICAN. Yet it is to be feared that all efforts to awaken the American people from their chronic condition of apathy and indifference concerning this most vital of all questions will prove futile. Nothing short of the shells of an enemy bursting in our midst will have any result.

To the writer it does not appear that the defenseless condition of the United States is solely chargeable to Congress. Congress reflects the attitude of the majority of the people, which is an easy-going "it-will-all-come-out-right-in-the-end" sort of optimism, always ready to "take a chance."

We should not overlook those imbeciles who profess to believe that we should put our trust in "moral force," whatever that is. Backed by connection with this or that university, the Church or the State, and closing their eyes to realities and their ears lest they should hear aught save the reverberation of their own voices, they harangue of airy ideals and millennial dreams.

The fact that we rigidly exclude the Chinese, who have nothing but this much-vaunted "moral force" supporting their demands for admission, while we allow the Japanese, who possess, alas, carnal weapons—a navy, an army, and guns—to regulate their own entrance into this country under the so-called "gentlemen's agreement," should be sufficient reply to the arguments of traitors of this type.

In conclusion, let me state that when the enlisted man is no longer regarded with thinly veiled contempt, when he ceases to be regarded by the people generally as a necessary evil, one may venture to hope that they are emerging from their fools' paradise.

San Francisco, Cal. JOHN H. GREEN.

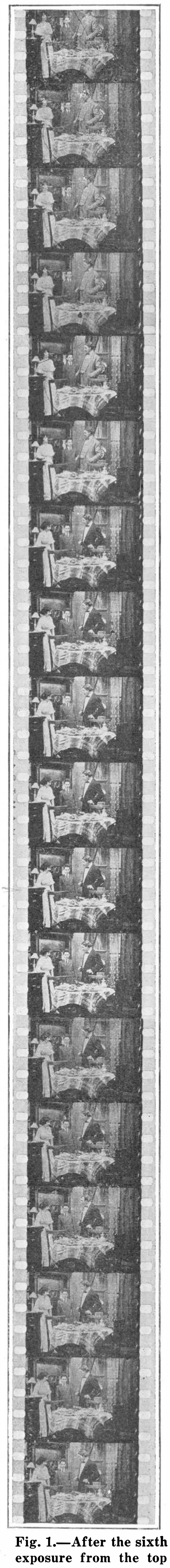


Fig. 1.—After the sixth exposure from the top the camera was stopped until the man had changed his clothes.

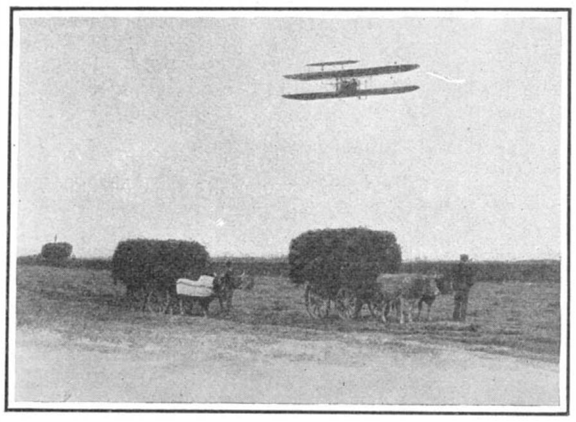


**Fig. 2.—A popular "Time trick photograph."**

The landscape was made at one time, the aeroplane at another, and printed into the sky.

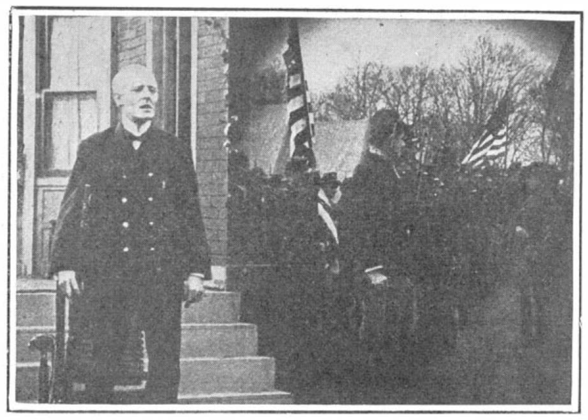


**Fig. 3.—Memories of other days.**

A scene made by printing in from two separate negatives, made at different times.

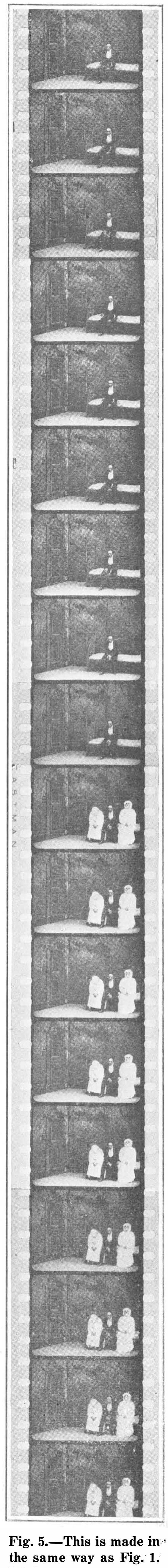


**Fig. 5.—This is made in the same way as Fig. 1. While the camera is stopped the two specters come in.**

# Motion Picture Magic

## Playing Tricks on Time

By C. H. Claudy

(Illustrated with Photographs Copyright by Thos. A. Edison, Inc.)

PHILOSOPHERS for centuries have speculated on the senses of man, and wondered why the number was five, and not six or seven or more. Literature is full of the mystic "sixth sense," which means anything the author of the moment may wish it to mean. Additional senses are popularly supposed to be those peculiar faculties which belong to the realm of psychics—second sight or inner hearing (clairvoyance or clairaudience)—but it is a fact that the everyday man has several senses beyond the five physical senses of sight, hearing, smell, touch and taste.

For instance, every one has a sense of balance. Strap a man to a board, blindfold him, and tilt the board. He will tell you unerringly whether he is head down or head up, and pretty closely at what angle he is. The aeroplanist, high in the air, knows whether he is level or tilted—yet neither learns the fact through any of his five senses.

Again, we have the sense of unconscious memory. The "bump of location," which the woodsman shares with the traveler, and by which each can find his way in strange places, is but an instance of memory of scene or street seen once before, not recalled in detail, but present in the mind, waiting to be called upon when wanted.

And we have a sense of time, most strange of all our senses beyond the usual five, least understood, and, when tricked, most prolific of wonder.

Many a railroad man learns to dispense with an alarm clock. If his call is for four-thirty in the morning, he will wake with a start at four o'clock. Many a man sets his alarm clock night after night, only to rise five minutes before it goes off, and stop it from waking the household. It is his sense of time which rouses him. Plenty of people—railroad men in the lead—can tell the hour to within a few minutes any time of the day without reference to a watch—again, the sense of time.

So accustomed are we to our mental valuation of the passage of time that when any event in our lives annuls this sense, or seems to go contrary to it, we marvel. No railroad man who has ever been in a wreck will need confirmation of the statement—he will remember how far apart the morning and the afternoon seemed, if the wreck came in between. Anything which jars us out of our daily course, which makes our minds take in new impressions rapidly, dulls our sense of time, and stretches it out, so that it seems longer than usual.

"I've had a long, long day," exclaims the man who has done much and unexpected business.

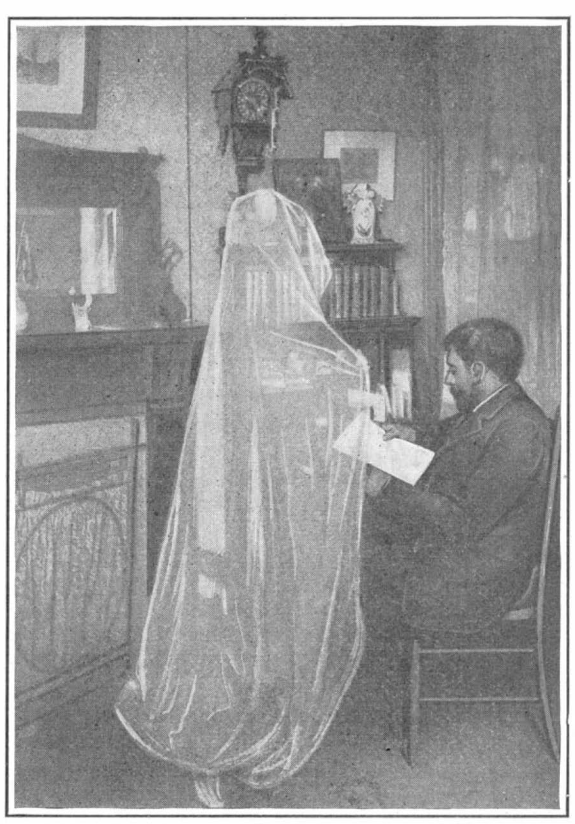


**Fig. 4.—The "sheeted ghost" is a time trick, the exposure being made as usual, after which the "ghost" walks into the scene and the rest of the exposure is made. The result is that the first exposure shows through the second, giving a "ghostly" effect. Two pictures made at two different times, appear as one—hence the trick.**

"The day was so short it fairly flew by," says the vacationist, resting at the seaside.

In the one case, the sense of time was inhibited, in the other hypersensitized—yet time was the same.

### Things That Affect Our Sense of Time.

Some people have a much keener sense of time than others. For instance, the clever boxer has a *time sense* which sharpens under action so that he actually lives at a different rate than those who watch. Not more rapidly, as we might think, but more slowly. Remember, the greater the number of new mental impressions, the slower the time seems to pass. The man in the wreck lives a week in an hour—the dentist's victim, possessing a sore tooth, finds five minutes stretch to the hour. The boxer, with his hypersensitive time sense, gets a greater number of sight impressions per second than a less clever antagonist. The flying fists he dodges so cleverly seem to him to move more slowly than they would to you or me, and because they seem to move the slower, because he sees them clearly in all the path of their vicious swings, he seems to himself to have plenty of time to dodge them. The ball player with "good batting eye" has the same trick of living slower for the moment, and so getting a greater number of sense impressions—he actually sees the ball in all its swift path from the pitcher's hand, and so has time to bring his ash against it, where you and I would but try to dodge a streak of white against the green.

The action of certain drugs slows up our living, sensitizes our time sense. Opium and hasheesh fiends live days, weeks, and months of experience, in a few hours, their time sense stimulated to the last degree. Did such drugs stimulate the body and its muscles to the same degree, a hasheeshed boxer would be irresistible. But, of course, such drugs affect the body in the exact opposite from the way they trick the brain.

The magician on the stage tricks not our eyes alone, but our sense of time. With two cages in plain view, he has a woman enter one, and draws a curtain about it. After a few words, he fires a pistol, drops this curtain, and we see the cage empty, while the other cage is suddenly inhabited by the same woman. We have not seen her pass from cage to cage—we know that she could not pass instantly from cage to cage, because people don't move twenty feet in an instant. Yet she is there. Our sense of time is outraged, and the result is "magic." Could we see the woman leave the first cage by a trap, walk under the stage, and enter the second cage by another trap, there would be no trick. But we are led to

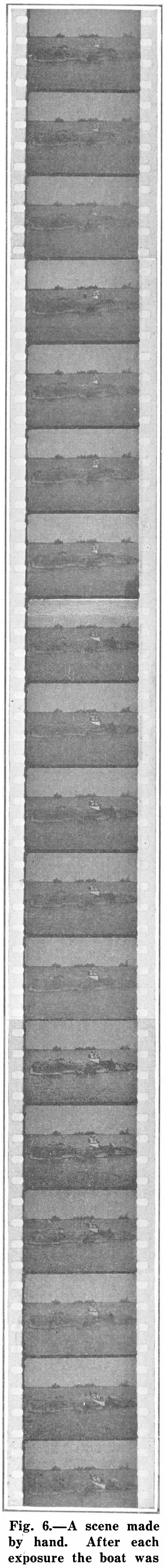


Fig. 6.—A scene made by hand. After each exposure the boat was moved forward a predetermined distance.

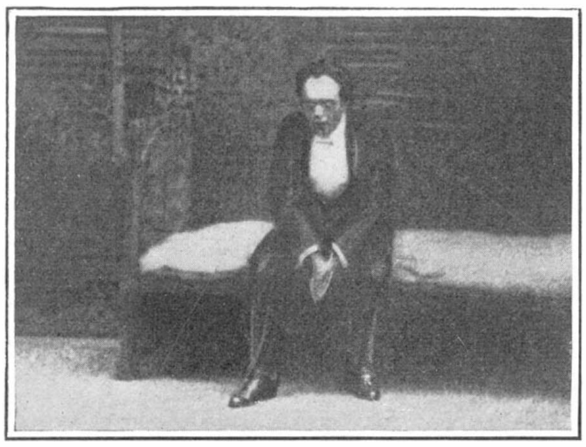


**Fig. 7.—This shows the first scenes of the film shown in Fig. 5, with a man sitting alone in a haunted house.**

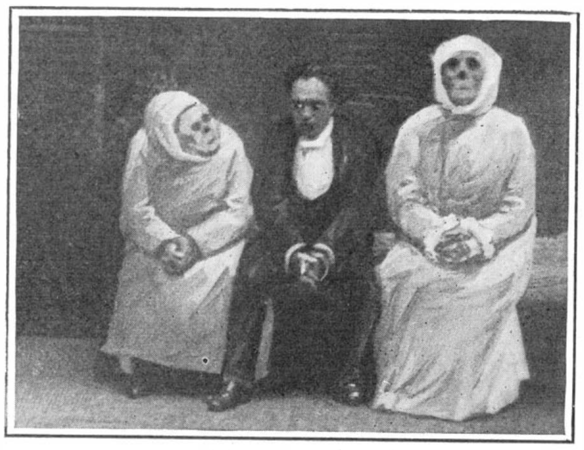


**Fig. 8.—In this scene the man asleep in the haunted house awakens to find a specter sitting on either side.**

believe the woman is in the first cage to the *instant* the pistol is fired—it is not the mere fact of her transfer from cage to cage which puzzles us, but her *instantaneous* transfer which our sense of time says is impossible.

**The Magic of the Screen.**

Wonderful as is the magic of the prestidigitator, however, it is as nothing to the magic which we see upon the screen when we watch a motion picture trick film. Here, at last, is the magic of our childhood—appearances, disappearances, apparitions, objects moving without apparent cause, people, trains and animals traveling at "impossible speeds," furniture endowed with life, inanimate objects possessed of the power of movement and of intelligence, even those things which the fairy power of Grimm and Andersen brought vividly before our minds' eyes made to seem real—trees growing up before our eyes, the rose shooting from the ground and blossoming in a minute or two. Things which we know are not possible are pictured for us—and we marvel, nor ever stop to think that all this magic and all its wonder are but a clever tricking of our sense of time, our mental valuation of an interval between ticks of the clock!

For the motion picture does for us what no other thing can do save a drug, or, in a slight degree, long, long training. It takes normal intervals of time and expands them one, two, a thousand-fold, or it takes a number of time intervals and compresses them by the same ratio. It presents all the motions of a growing flower in a month's time to our eyes in the space of five minutes—or it takes the time intervals between the several inches of progress of a flying bullet—a tiny fraction of a second—and expands them so that they occupy perhaps the half of a minute. It eliminates the time between happenings and brings two events separated actually by hours of time and makes them seem to us as following each other with no interval between them. More, it takes two happenings at different times and at different places, and makes them appear to us as happening at the same time and same place. Unconscious of this strange sixth sense of time, because it is so much a factor of our daily lives, ignorant of the fact that it is this and not our eyes alone which have been tricked, we leave the darkened theater with wonder in our hearts and admiration on our lips.

**How Is It Done?**

"Now, how do you suppose *that* was done?" is our nearest guess.

Let us take some of these "time tricks" to pieces and see just how they are accomplished. Most of us have seen thrown upon the screen a picture of a patch of earth in a garden. We have watched the clods disturb themselves, seen a slender shoot put its point up through them, watched in wonder the green tip twirl and twist as if seeking the light, seen it climb up a wall, putting forth tentacle-like hooks and fasten them about the ready wires, then shoot forth leaves, then a bulb, which, opening before our astonished eyes, becomes a morning glory. If not that flower, then we have seen a rose, a lily, or a carnation, push the earth aside and grow to full maturity in a few minutes by the magic of the motion picture.

How this is done is as wonderful as it is absurdly simple. The ordinary motion picture is projected on the screen from a film which passes sixteen separate pictures through the machine every second. It was made in a camera which took sixteen separate pictures every second. We see sixteen separate pictures every second, each one slightly different from the one previous. Were our picture of a growing flower made in that way, we should sit and watch the screen for as many weeks as it took the flower actually to grow. But the flower picture, though projected at the rate of sixteen pictures a second, was made in a different way. The camera was set up in front of the place where the flower was to grow, and, by a clockwork device, was made to take the picture, not every sixteenth of a second, but every fifteen minutes! At the end of a month, supposing the camera ran night and day (at night by electric light), there would have been made 2,880 pictures on a strip of film. If these pictures are run through the projecting machine at the rate of sixteen per second, the whole film passes through the machine in three minutes. We see 2,880 pictures of a growing plant. In actuality, a period of fifteen minutes separated each of these pictorial impressions of the growth of the flower. On the screen, this fifteen minute interval is "squeezed up" 14,400 times—from fifteen minutes to the sixteenth of a second. For the three minutes we look at the presentation of the growing flower, our time sense has been speeded up so that we get in three minutes the impressions that the camera got in a month.

To get this impression in actuality, we should have to find a drug which would slow us up, so surely to the senses, that a month seemed as three minutes. Hasheesh is such a drug, but as it paralyzes all bodily activity, including sight, the only things the hasheeshed brain sees at abnormal speeds, great events taking place in minute times, are the disordered fancies and portraitures of the wandering human mind.

**Fig. 9.—This shows a scene in the film shown in Fig. 1 before the change of costume was made.**

**Fig. 10.—Same setting as Fig. 9, but here the man has changed to a dress suit, while the camera was stopped.**

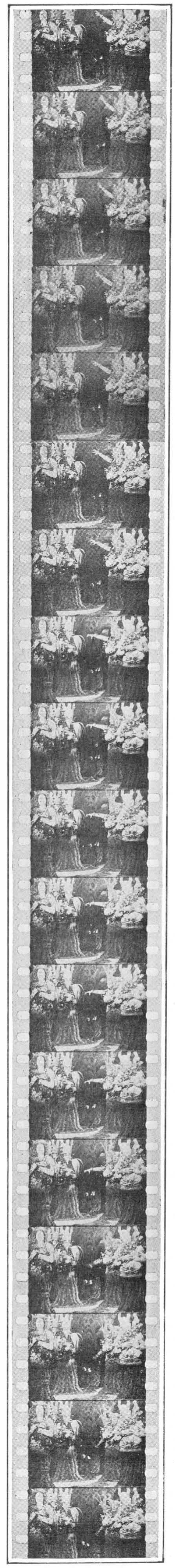


**Fig. 11.—Specimen of multiple exposures and printing. Fairies and faces terrify the small man.**

# Your Panama Hat

## From the Tropical Jungles of South America to the American Hat Store

By A. M. Jungmann

WHEN you get ready to put on your Panama hat this season view it with renewed interest. It is about the only article of apparel which is still being made in exactly the same way it was when these hats came into being centuries ago, before Columbus discovered the Americas. That is, of course, if your Panama is a real Panama. And speaking of real Panama hats, in point of fact there is no such thing. Panama hats are not and never have been made in Panama. They acquired this false name because the city of Panama was and still is the great distributing center for this particular variety of hat.

Panama hats are woven from the leaves of *Carludovica palmata*, a low growing, sturdy member of the palm family, and the finest of them come from Ecuador; others are made in Colombia and Peru. This palm, of which there are half a dozen varieties, grows wild in the semi-darkness of the tropical jungles of the Pacific coast of South America. In selecting its leaves for hat making care is exercised to take the young unopened leaves. These are pliable, white, and larger than the developed leaf. The rough outer layers of the leaf are cast away and the smooth, white inner layers which lie folded fanwise are carefully cut into, literally, thousands of fine shreds or strips varying in size from pieces as fine as the hair of a horse's tail to strips as thick as ordinary twine, according to the quality of hat to be made.

The knife used for this operation is very thin and sharp and considerable skill is necessary to cut the leaves, for the strips must not be separated from the parent stem of the leaf. The leaf when cut is known as a "cogollo." A number of leaves so prepared are tied together by the stems and submitted to a process of steeping in boiling water. After this they are bleached by methods known to the natives and are then ready to be woven into hats. The preparation of the "cogollo" is an entirely separate industry from that of the hat making. Each "cogollo" contains on an average twenty-eight straws about 50 centimeters long and weighs usually 15 grammes. The price the weaver pays for this material varies according to the fineness of the texture of the "cogollo" and the even coloring of the straws.

The hats are not woven in factories, but in the homes of the weavers. Sometimes an entire family is engaged in weaving. In the more remote districts where community life does not exist all the members of a family are provided with "cogollos" of a fineness of texture suitable to their individual skill. The children are supplied with the coarsest straws and the older and more experienced weavers with finer material. Where the population permits, the weavers gather into congenial groups. The young men of the village congregate each day and weave in little groups, lightening the time of toil with jokes and stories. Similarly the girls form pleasant weaving parties and sing while their fingers are busy with the palm strands. The older people are apt to gather together according to their skill, but there is usually one weaver whose art is so far ahead of the others that he or she is set apart and generally regarded with a generous amount of admiration or envy, as the case may be. On the whole, however, these people are of a pleasant, though somewhat phlegmatic, disposition.

The utmost perfection in weaving has been attained in the districts of Jipijapa, Montecristi, and Santa Ana, province of Manabí, Ecuador. Some of the hats produced there are almost as fine as a linen handkerchief. Such hats bring very high prices right where they are made. Wealthy planters affect them, and it is not uncommon for the equivalent of $50 to be paid to the weaver for one of these fine hats.

When one of the aristocrats desires to make a princely gift to a distinguished acquaintance, he visits the most famous weaver, say, in Jipijapa and makes known his particular desire in a hat. The weaver then devotes all his time to filling the order and when the hat is completed receives a handsome sum for it. But no matter what the pay, it surely is well earned, for the weaving of such a hat requires an amazing amount of skill and knowledge of the best sort of "cogollo" to go into its construction. Also it takes an entire season to complete one. These adepts at weaving develop a sensitiveness in feeling comparable only to our blind who have been taught to use their fingers as their eyes. The sense of touch must be delicate in the extreme to turn out the exceptional Panamas. These wonderful gift hats, which rarely ever are seen by ordinary mortals, have a texture as fine and supple as a piece of Lyons silk. The weaver who is selected to make one attains great honor in his village. Not many of the best hats are brought to this country. In the department of Antioquia, Colombia, there are weavers who turn out hats which almost any American would be glad to own, but they do not equal the Ecuador product. There is but one place in Peru where the industry flourishes, and that is in the small town and district known as Catacaos, in the province of Piura. These hats are shipped from Paita. In the countries where Panama hats are made there are but two classes of people, the rich or aristocratic class, and the poor or serving class. Many of the hats which usually find their way to the United States and are sold at moderate prices are made in Peru. They would be spurned by the upper class in the land where they are woven and could be found only on the heads of the downtrodden poor.

Copyright by Clarke & Hyde.

**How Panama hats are bleached after they are received.**

Copyright by Clarke & Hyde.

**Panama hats are received in crates—thousands of dollars worth in a single crate.**

The Panama hat, like "all Gaul," is divided into three parts. The top of the crown is called the "plantilla," the sides of the crown "copa," and the brim "falda." In beginning the hat the weaver selects eight straws which constitute the skeleton and run from the center of the "plantilla" to the edge of the "falda." While it seems that these straws could be arranged in only one way, the different localities where the hats are made each has a method of handling the skeleton characteristic of that particular school of weaving, and the placing and design of the skeleton straws are unfailing indications, to the initiated, of the place of manufacture of a Panama hat.

Starting at the center of the "plantilla," the weaver builds a series of concentric braids. Each of these fine circles is called a "carrera." The greatest manual dexterity is necessary to handle these delicate straws and interweave them with the skeleton straws, yet keep the whole symmetrical. In order to facilitate the bending and turning of the straws, the weaver keeps that part of the hat on which he is employed wet by means of a mop of straw, which he dips into a vessel of water at his hand. The entire hat is never kept wet; only a very small part of it at a time. When the crown is completed and the time comes to join the brim on to the crown, the weaver slips the crown onto a block and then attacks the "carre," as the juncture of crown and brim is called. I suppose efficiency engineers will be shocked to learn that in this day and generation the weavers of Panama hats still persist in the ancient and tuberculosis encouraging habit of holding the block in place with their chests instead of adopting a more healthful and up-to-date method. The weaver now completes the tortuous ordeal by finishing off the brim border or "remate," as he calls it. The brim is then pulled into shape by a series of firm twists and pulls and the block removed.

The loose straws which stand out, halo-like, around the border of the brim are carefully trimmed off, and the hat is ready to be washed and bleached. After all the soil has been washed out and it has been given the desired whiteness, it is once more put on a block in preparation for the process termed "masetear," which means to be beaten with a wooden hammer. This calls for great skill, for as the hammer is manipulated so is the appearance of the hat changed. When the hat looks the way the weaver wants it to be he stops beating it and very gently and painstakingly proceeds to iron it. This then completes the process and the hat is packed with its fellows to begin its commercial adventures. The hats are stacked one within the other and between them sulphur is liberally sprinkled to prevent moulding, something which must be constantly guarded against in humid, tropical countries. Occasionally when hats arrive at the distributing centers they have dark spots on them, which are not readily removed. There is a certain preparation which is sold for the removal of these blemishes, but for some reason the formula has been kept a secret.

When the hats are finished they are taken to the nearest market place on market day and there sold to the dealers by their makers. These markets are picturesque in the extreme. The gaudily dressed natives, the women wearing innumerable petticoats, the haggling crowds, the colorful display of vegetables, hats, clothes, and a thousand and one interesting objects, not forgetting the quaintly hideous charms sold by the Indians, the patient pack animals all go to make up a scene almost incredibly unique, for to-day it is just as it was generations ago. Progress has not reached the market places where Panama hats begin their journey into the great, bustling world.

The weavers of the very finest Panama hats do not need to belong to a trade union to insure their working days being shortened to accepted standards. They work on an average of from six to eight hours a day, divided into periods of from three to four hours each morning and evening, because they can handle the fine straws only when there is a certain amount of humidity in the atmosphere. During the middle of the day the air becomes too dry for successful manipulation of the delicate strands of palm leaf. The coarse hats may be woven at any and all hours.

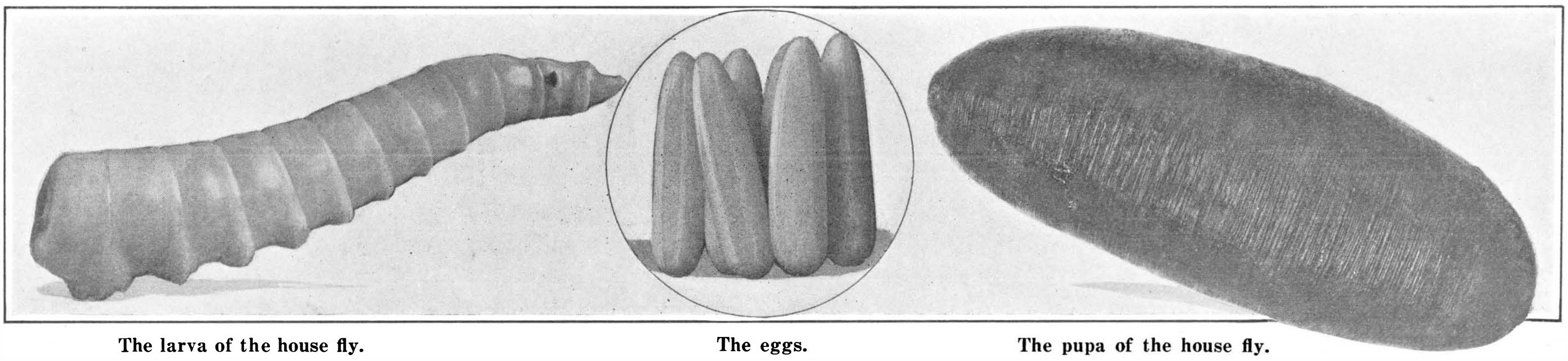
When purchasing a Panama it is a good idea to hold

*(Concluded on page 461.)*

# The Fly

## A Model of Musca Domestica 64,000 Times Life Size

By Joseph William Grigg



The larva of the house fly. The eggs. The pupa of the house fly.

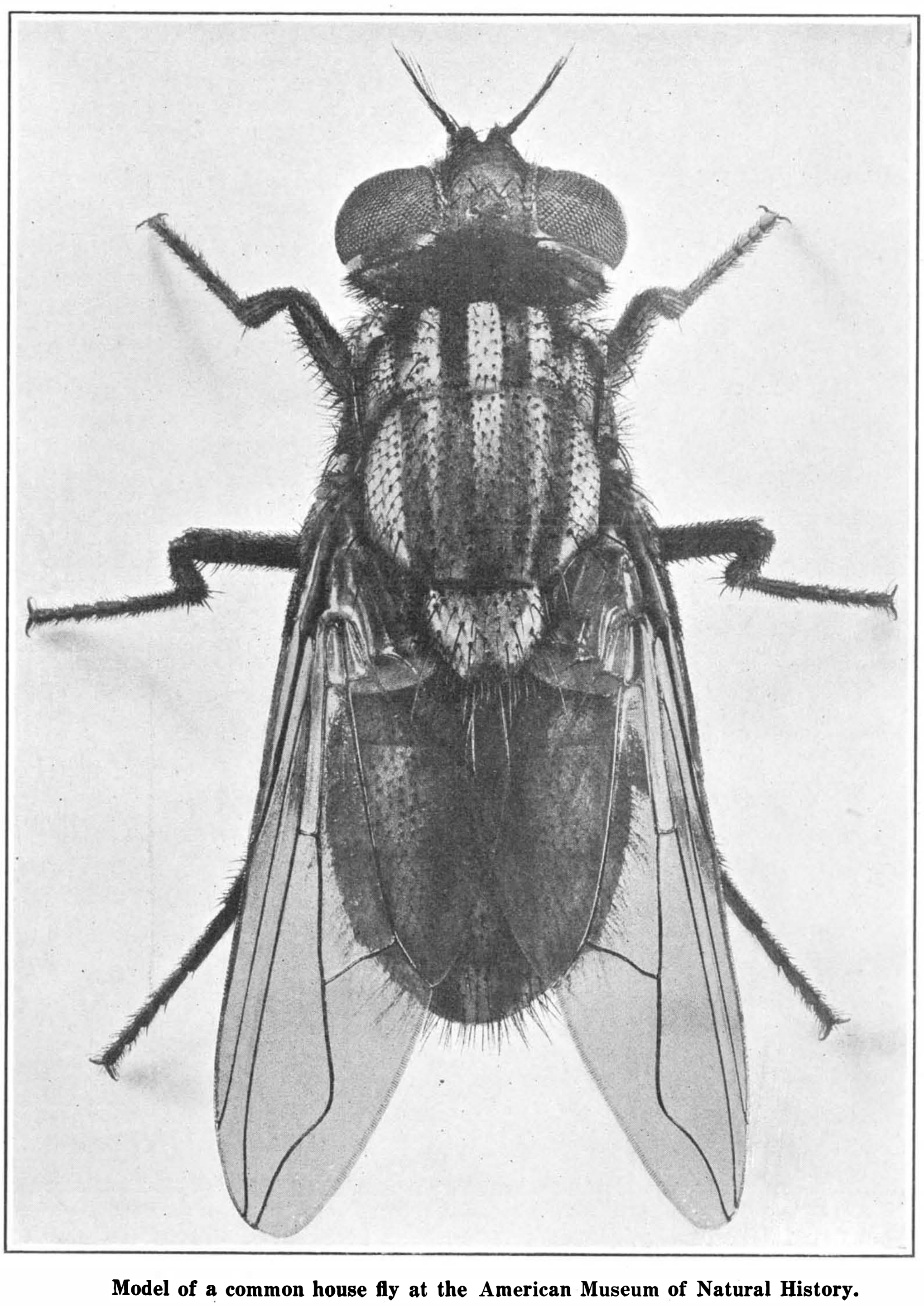
AT the American Museum of Natural History you will find a house fly nearly as big as a cat, and all its disagreeableness will dawn upon you at once. The model of the house fly is 15 inches long, or 64,000 times the size of the living *Musca domestica*. It is considered the most accurate and adequate representation of the external anatomy of the house fly in existence. Not only have the more striking features been copied, but even the minor details visible on a magnification of forty diameters have been executed with complete accuracy. The eggs, larva and pupa of the fly, executed in proportion to the model, are part of the group.

The model is a graphic illustration of the life story of the fly. Man has fostered and tolerated the insect since time out of mind in all but the coldest climates of the world. The model shows the short interval from the time the eggs are laid in organic refuse to the quick development of the hungry young grub and the pushing aside of the hard case with a loose top segment and the exit of the perfect insect. It is easy to understand the fly's rapid multiplication. It has been computed that if a fly on June 1 lay one of the six installments of one hundred and twenty eggs of which it is capable, that by September it would have a progeny numbering septillions. In figures, by September 18 the number of flies resulting from that first batch of one hundred and twenty eggs would be 36,279,705,600,000,000,000, which in turn would lay 4,353,564,672,000,000,000,000 eggs. This would take into account an equal division of males and females. The possibilities for contamination can be readily conceived when it is known that the bacteria on a single fly have been known to range from 250 to 6,600,000.

No one group in the museum has created more interest than this one of the house fly, a member of the family of 40,000 species of flies in existence. There is small wonder. Of all insects captured in houses in this country in a survey in recent years 98.8 per cent were house flies.

Ignaz Matausch labored for more than a year to produce the fly model and other parts of the fly group. As a first step he studied 200 flies, stupefied with chloroform or freshly killed. This was necessary, because within half an hour of death the color of the fly as well as the surface modeling changes. Even the color of the eyes was found to change a short time after death. Each specimen could, therefore, be used only for a short period.

Drawings were made of anatomical details, and are now in the museum. The head, mouth parts, body and legs were modeled separately in clay, cast in wax and smoothly finished, polished and colored. The eyes were produced with glass beads. The hardest part of the work was the insertion of the hairs with which the body of the fly is covered. It was more difficult because the hairs vary in length and bend in different directions. This was finally accomplished by constructing each hair of german silver wire. The wings were modeled in celluloid. The halteres (a rudimentary second pair of wings), the plume-like antennæ, the club-shaped palps or tasting organs were all accurately modeled and articulated into position. A magnified rectangular crumb of bread forms the mount for the fly.



Model of a common house fly at the American Museum of Natural History.

### The Pacific Kelp Beds

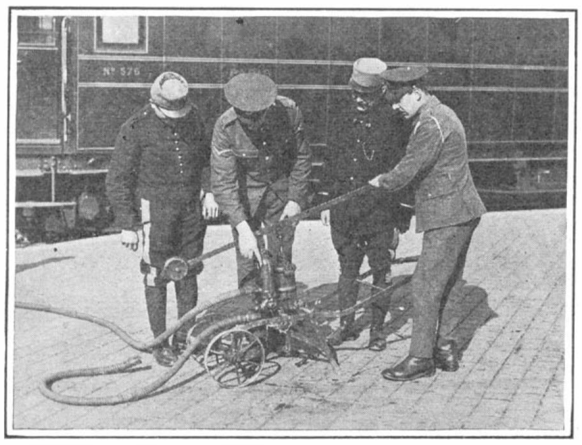
IN the bill making appropriations for the Department of Agriculture for the fiscal year ending June 30th, 1915, authority was provided to print and publish certain maps and accompanying reports relating to the kelp beds of the Pacific coast. These documents have just appeared in the form of a bulletin by Frank K. Cameron and others, entitled "Potash from Kelp," accompanied by a folio atlas showing the results of the surveys made of all the commercially available kelp beds from Cedros Island to Cape Flattery, about half the available beds in southeast Alaska, and a major part of the beds on the southern shores of the Alaska Peninsula. The maps, which are sixty-one in number and drawn on a large scale, show the location and extent of the beds, and also, by means of various tints, their character, whether thin, medium, heavy, etc.

This report, besides containing a handy *résumé* of much that has been previously published on the subject of kelp and the domestic potash supply in general, presents several new facts of great practical interest. The botany and life-history of the giant kelps are extensively discussed, chiefly from the point of view of utilization. The mode of growth of *Macrocystis* makes it possible to harvest the plant twice a year without danger of destroying the beds. Cutting of the stipes causes new stipes to grow out from the holdfasts, somewhat after the manner of the "stooling" of wheat. *Nereocystis* is apparently an annual, and more care must be taken to avoid permanent injury to the beds; i. e., harvesting should not take place earlier than the fruiting season. In the Puget Sound region this plant should not be harvested before July 15th, and in Alaska not before August.

As to the disposition after harvesting, it is stated that "taking everything into consideration—cost of production, cost of handling, and properties which will appeal to the manufacturer of mixed goods—dried powdered kelp is the product which seems to offer the best possibilities for quickly finding a substantial commercial demand."

Sections of the report are devoted to the methods of harvesting kelp, with working drawings of harvesting machinery now actually in use in California, and to a discussion of probable markets. The legal status of the kelp beds has aroused some controversy, and uncertainty on this subject has deterred large capital from undertaking their exploitation. Legislation looking to the control of the beds and leasing of the rights to harvest has been proposed in the States of Washington and California, but has not yet been effected. At present, anybody is free to harvest kelp anywhere on the coast.

The area of commercially available kelp beds on the Pacific coast is given as 389.94 square miles and the weight of fresh kelp as 59,305,500 tons. Assuming that all the potassium chloride were extracted and marketed as such, it is said that its value at present prices would approximate $90,000,000, while if the crop were reduced to dried kelp and sold at current figures for potash and nitrogen content, the value would exceed $150,000,000.



Photograph by Underwood & Underwood

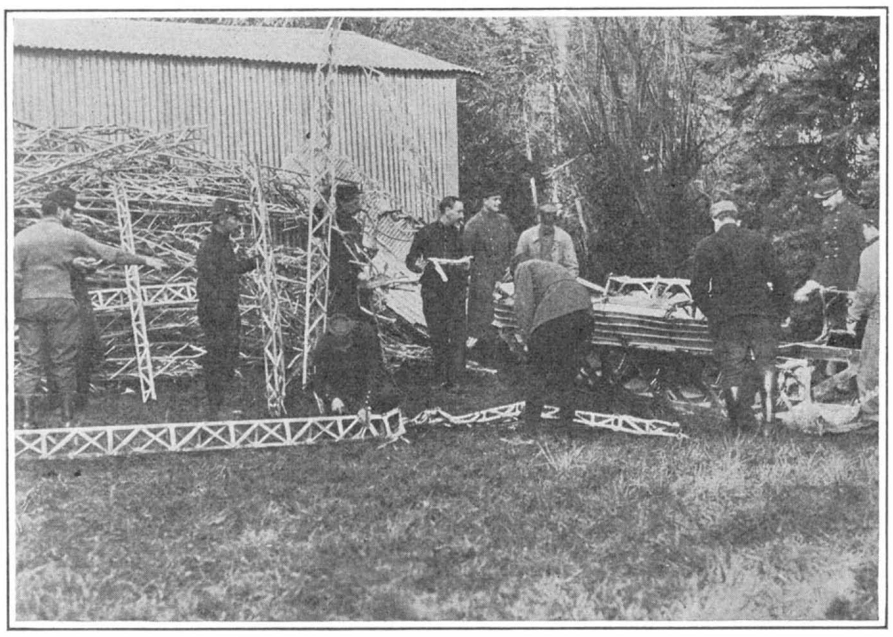
British soldiers explaining to French officers the operation of a trench pump.

Copyright International News Service

Clearing away wire entanglements by shooting a cable over them and hauling it in.

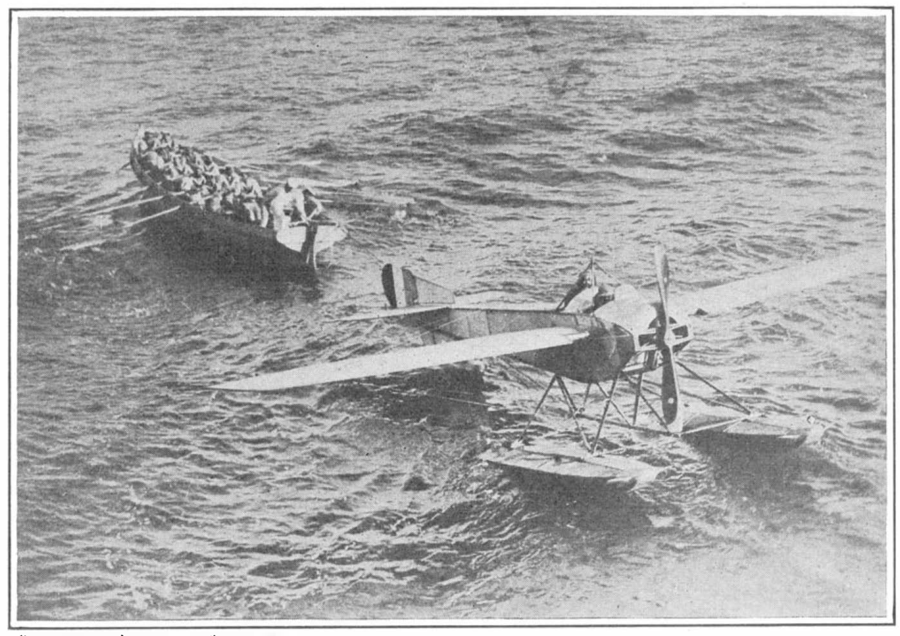
Copyright International News Service

Incendiary bombs dropped from Zeppelins in a raid over the Tyne, England.



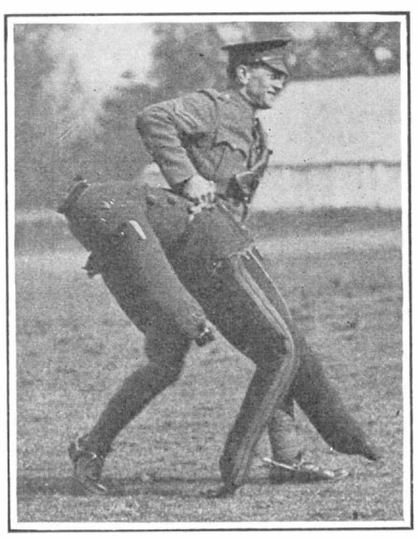
Photograph by Underwood & Underwood

French soldiers breaking up the framework of a fallen Zeppelin.



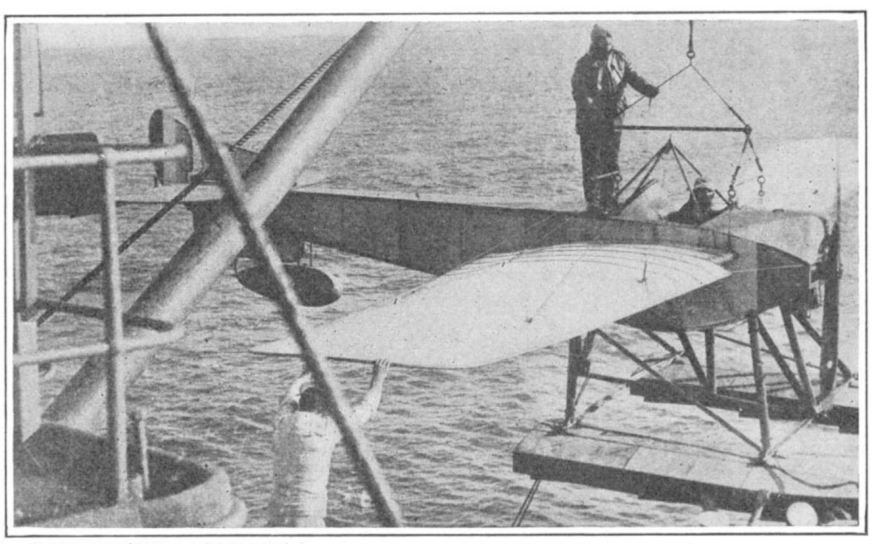
Photograph by Underwood & Underwood

Towing a seaplane back to its mother ship at the Dardanelles.



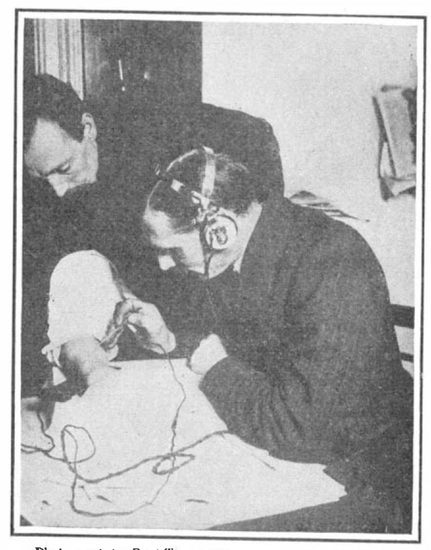
Photograph by Underwood & Underwood

Victoria cross race in which each competitor carries a dummy.



Photograph by Underwood & Underwood

Hydroaeroplane being taken aboard a cruiser after a flight over the Turkish fortifications at the Dardanelles.

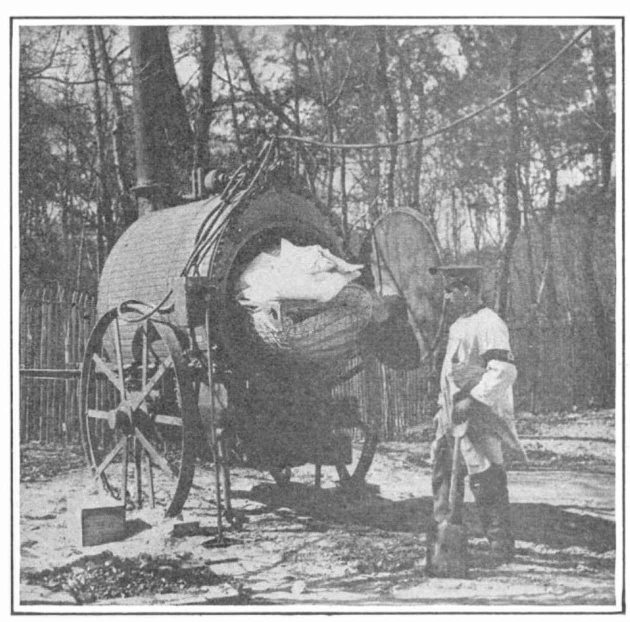


Photograph by Paul Thompson

Sir James Makenzie Davidson's method of probing for bullets with a telephone.

Copyright International News Service

Austrian motor transport bringing in a load of benzine for automobile fuel.



Photograph by International News Service

Disinfecting clothes at a British field hospital.

SCENES IN WAR-TORN EUROPE

## RECENTLY PATENTED INVENTIONS

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

### Pertaining to Apparel.

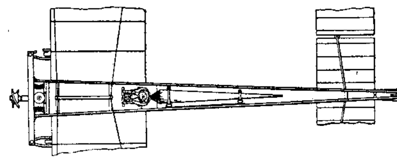
PUTTEE.—ARTHUR D. MOLONY, London, England. The invention has for its object to add comfort to all forms of putties for hard wear, especially military, without diminishing their strength; and to adapt putties, as neater, more efficient and comfortable articles of wear, to many new uses, chiefly sporting, for which the gaiter or combination of Highland spat and

WOVEN PUTTEE FOR HARD WEAR.

stocking has been worn hitherto. To this end, the invention is characterized by a woven puttee having the warp or longitudinal strands retained jointless and continuous throughout, and having the weft or transverse strands changed in one or more suitably located longitudinal sections of the puttee.

### Pertaining to Aviation.

SAFETY DEVICE FOR AVIATORS.—W. A. MACKAY, care of Mackay Colliery Co., North Sydney, Nova Scotia, Canada. The invention has particular reference to devices for making flights of aviators practically safe in the provision of a parachute adapted to be carried by the machine and to which the aviator is connected, means furthermore being provided



SAFETY DEVICE FOR AVIATORS.

whereby the parachute and aviator may be released from the machine in the case of accident and enabling him to be lowered to the earth in safety by virtue of the parachute. The use of the device for releasing an aeroplane and making the pilot independent of starting his machine without assistance, is important in face of the fact that aviators have not been partial to parachutes or life-saving devices of any description.

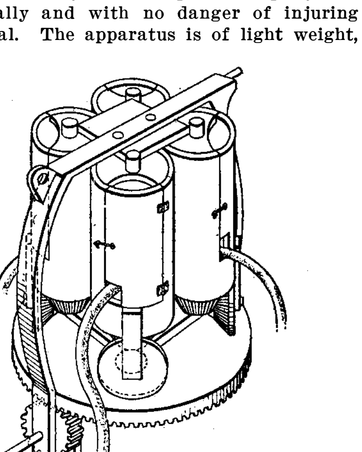
PROPELLER.—T. A. MACDONALD, 59 Fair St., Paterson, N. J. An object here is to provide a propeller, especially those designed for aeroplanes, which not only exerts a driving force in the direction of flight, but also exerts a lifting force, this lifting force being due to the peculiar shape of the blade of the propeller.

### Of Interest to Farmers.

COTTON CHOPPER.—R. HAMILTON, P. O. Box 521, Commerce, Tex. This invention comprises a wheel supported frame having a series of adjustable chopping devices for cutting out all of the plants in the row except those which it is desired to retain, and in which each of the dropping devices is mounted on an adjustable support which carries fenders and cultivating mechanism for cultivating the plants after thinning.

TRAP NEST.—M. F. DONAHAE, 521 S. Main St., Providence, R. I. In this device a nest is provided for the fowl and an inclosure for the nest having an entrance and an exit, and wherein doors are provided for entrance and exit, and mechanism in connection with the doors for normally closing the door of the exit and opening the door of the entrance, and arranged to be operated by the weight of the fowl as it enters the nest for closing the door of the entrance and opening the door of the exit.

MILKING MACHINE.—A. TRUCHOT, Choteau, Mont. By means of this device the milking of a cow may be accomplished rapidly and economically and with no danger of injuring the animal. The apparatus is of light weight,



MILKING MACHINE.

and is adjustable so as to permit the movement of the animal during the milking operation. The milking operation closely simulates that of manual operation.

DRAFT APPLIANCE FOR SELF-LOADING GRAIN CARRIERS.—J. E. MOSCRIP, Derrick, Saskatchewan, Canada. This invention relates to harvesting machinery and has particular reference to propelling means or draft appliances for machinery intended for the purpose of gathering a load or bulk of hay or shocks of grain while moving across a field and then transporting such load to the place of delivery.

### Of General Interest.

OIL FILTER.—E. P. BAUM, 1027 South Main St., Ottawa, Kan. This filter is designed to be reliable and efficient in use and to filter from the oil the minutest particles it may contain, and including filtering elements which can be readily taken out of the tank or body of the filter for the purpose of cleaning or renewing.

HELMET.—F. M. BOWERS, Chester, Penna. The purpose here is to provide a helmet or mask which can be easily placed from operative to inoperative position without removing the same from the head of the wearer, which helmet or mask affords a large angle of vision when in use, leaving both hands of the wearer free for work.

RECEPTACLE COVER AND SPOUT.—M. BLUME, 1405 8th Ave., Brooklyn, N. Y., N. Y. This invention relates to a combination cover and spout for a receptacle, and more particularly for a milk bottle. An object is to provide a receptacle cover and spout which can be easily and quickly secured to or removed from a receptacle and which can be easily cleaned, thus rendering the device sanitary.

LITHOGRAPHIC PROCESS.—M. R. WOOD, 218 William St., New York, N. Y. The particular result attained by the process is in the production in ink, on one object, of the effect of a design printed upon linoleum with oil pigments, in order to produce light and inexpensive samples of the various designs of linoleum, and avoid the necessity for carrying heavy and cumbersome sections of the linoleum.

EGG TESTER.—H. NIEHOFF, Flower Co., 49 Broadway, New York, N. Y. The invention has reference to an electric egg tester adapted to be used by housewives in testing the eggs they purchase, and also by egg merchants, whereby eggs can be easily and quickly tested to ascertain their degree of freshness.

PARCEL POST WEIGHING SCALE.—G. B. JUSTICE, Raleigh, N. C. The improvement is embodied, first, in an attachment for the scale-pan, consisting in the provision of a map and a guard superimposed thereon and marked with zone lines. The guard is in the nature of a transparent plate on which concentric circles are inscribed indicating different zones. By shifting the map, any particular town or unit of area may be brought to the center of the pan and the guard, and thus the scale may be conveniently made to apply to any particular town or unit of area.

FINE ORE SEPARATOR.—C. W. BELL, Rickey, Ala. The invention provides a device especially adapted for separating ore from other substances having different specific gravity, wherein the separation is based on the physical fact that such materials are moved by flowing water at different velocities, the relative velocity depending upon the relative specific gravity.

GARBAGE CAN.—J. A. JONES, Palestine, Tex. The invention relates to garbage and trash receptacles, and one of the principal objects is to provide a garbage receptacle adapted for use on sidewalks and in public parks, and including foot-operable mechanism whereby the lid of the can may be easily opened incident to the depositure of the trash or garbage therein.

### Hardware and Tools.

MOLD FOR SECURING SCREEN WIRE.—C. C. BROOKS, Sheffield Station, Kansas City, Mo. One of the principal objects here is to provide a mold whereby screen wire may be detachably secured, and held in stretched position, on doors, windows, screen frames, sleeping porches and other places where wire screens are desired, the mold itself adapted to be formed into a frame.

COMBINATION TOOL.—J. H. WALKER, 120 W. High St., Lexington, Ky. This tool is adapted for use in carpentry, drafting, masonry and other work of a similar nature. The invention provides a tool which may be used as a straight edge and rule; a double right angle square; a double try-square; a double bevel square; and a double protractor.

### Heating and Lighting.

ADAPTER FOR BUNSEN BURNERS.—J. I. ROBIN, 198 Broadway, New York, N. Y. According to this invention, the disadvantages of former inventions are overcome by providing a fitting which is such that it may be fitted to any standard burner attachment or mixing chamber and which is provided with any convenient number of burners or mantle supports as may be required, depending upon whether the burner is required for heating or lighting.

### Machines and Mechanical Devices.

VALVE.—C. O. NILSSON, Ravenswood, W. Va. Mr. Nilsson's invention is an improvement in valves, and has for its object to provide a valve of the character specified, especially adapted for use as an exhaust valve in explosion engines, and especially of that type using the puppet type of valve.

SHIP SCALE.—J. FRAME, Searsport, Maine. This invention pertains to scales and particularly to scales for weighing ships and the cargo of ships, and has for an object to provide an improved structure wherein the ship may be weighed at any time when empty, and the cargo may be weighed as the same is taken on board.

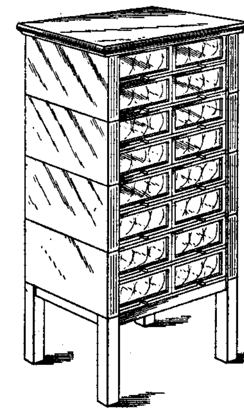
MANUFACTURE OF HOLLOW OR LIKE EARTHENWARE.—E. W. LEIGH, Ambleside, Midway, Burton-upon-Trent, England. This invention has for its object to construct a machine for the manufacture of hollow or like earthenware, such, for example, as pots or jars, for containing preserves and other foodstuffs. The pieces of clay or the like from which the pots are formed preferably consist of approximately circular solid billets or slabs prepared in any ordinary manner.

SHINGLE PRESS.—O. HORNBY, care of N. W. Lumber Co., Hoquiam, Wash. The improvement provides means for automatically pressing shingles in their bundles to tighten the shingles in the bands which hold the shingles together. The press is disposed between two gravity roller sections and these sections are connected with the press for operating the press automatically as the bundles of shingles pass from one of the roller sections to the other.

UMBRELLA COVERING MACHINE.—KATHERINE C. HOUT, 13 Chestnut St., Schenectady, N. Y., and C. T. HENTSCHEL. The invention provides means for mechanically mounting on an umbrella frame a fabric cover; provides means to operate rapidly to operate means for manually controlling the periods of operation of said machine; and provides fastening members for the cover and the outer or tip ends of the ribs of the umbrella frame, arranged in the form of a continuous strip, to facilitate the feed of the fasteners.

### Musical Devices.

MUSIC CABINET.—M. A. HAWKINS, 1532 Druid Hill Ave., Baltimore, Md. This invention provides for accommodating the maximum number of music rolls in a given space; embodies the novel elements in a form constituting units of a sectional cabinet; provides trays for the music rolls, each adapted to hold a



MUSIC CABINET.

series of rolls and accommodate rolls of different diameters; provides for holding the rolls of a series in parallel orderly relation on the trays; and provides a sliding music roll holder, and at a door at its front together with connecting means for actuating the door to the movements of the sliding holder.

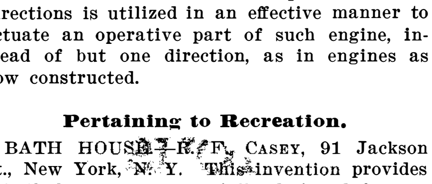
### Prime Movers and Their Accessories.

ROTARY INTERNAL COMBUSTION ENGINE.—F. H. KILWINSKI, U.S.S. "San Diego," care of Postmaster, San Francisco, Cal. This invention relates more particularly to a rotary internal combustion motor or engine, which has for its object the provision of a device which simplifies the structure of engines and reduces the number of parts to a minimum, and in which greater efficiency is obtained by the omission of complicated working parts resulting in lost motion and necessitating their frequent repairs.

INTERNAL COMBUSTION ENGINE.—O. HEATON, care of W. Heaton, Rushville, Ill. The invention relates to engines particularly designed for heavy fuel oils, and the main object thereof is to provide an explosion chamber in which the force of the fuel explosion in two directions is utilized in an effective manner to actuate an operative part of such engine, instead of but one direction, as in engines as now constructed.

### Pertaining to Recreation.

BATH HOUSE.—F. F. CASEY, 91 Jackson St., New York, N. Y. This invention provides a bath house more especially designed for use on rivers, bays and other waterways, and arranged to provide a basin adapted to float independently of the bath house structure and the platform adjacent the basin to protect the latter against heavy swells and waves and thus allow of keeping the basin watertight.



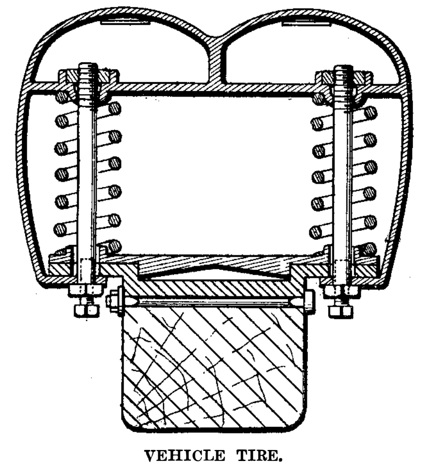
BATH HOUSE.

TOY.—J. T. MILLER, Clovis, New Mex. This invention provides a series of toys driven by spring motors, capable of being wound, and arranged to move the figures forwardly by successive starts and stops, and wherein mechanism is provided in connection with the motors for successively releasing and restraining the operation of the motors, and wherein certain of the figures are mounted to be moved in certain predetermined manners by the motors.

### Pertaining to Vehicles.

ELEVATING TRUCK.—E. M. CHAPMAN and C. E. COWAN, 229 Chestnut St., Holyoke, Mass. This invention has reference to elevating trucks of that type including a link supported platform and means whereby the downward movement of the handle will elevate the platform and the upward movement will lower the platform.

TIRE.—C. L. NEELY and F. K. NEELY, Corydon, Iowa. The main object in this instance is to provide a substitute for the pneumatic tires now in use which will not require inflation by means of air, thereby avoiding all the tire troubles now experienced. A further object is



VEHICLE TIRE.

to so construct the tire that lateral resiliency of the same is possible as well as the vertical resiliency. The invention provides means for increasing or decreasing the compression of the resilient devices at will, whereby the tires may be adjusted to a contemplated load.

AUTOMOBILE TOP LIFTER.—L. JOHNSON. Address W. S. Leyens, Monroe, La. This improvement provides mechanism for use in connection with automobiles and like vehicles having extension tops, for permitting the top to be raised from one of the seats, without touching the top, and without the necessity of alighting from the vehicle.

GUIDE FOR VEHICLE SPRINGS.—M. W. MORRIS, Olympia, Wash. This inventor provides a guide for springs of light automobiles, such as those in which the springs are disposed transversely of the car. The device may be readily attached to or removed from cars without necessitating the dismantling of the parts or of weakening or in any way interfering with them.

FRONT RUNNING GEAR FOR VEHICLES.—M. L. JOHNSON, Galena, Ill. The invention is an improvement in the forward axle-support of four-wheeled vehicles, particularly such as are self-propelled, the objects being to provide elimination so far as practicable of side thrust, and twist or torsion in passing over uneven surfaces, and to locate the point of pivotal connection between the front axle and the chassis as low as practicable.

VEHICLE END GATE.—J. A. RAMSEY. Address L. Crocker, Allen Block, Beatrice, Neb. The primary object of the inventor is the provision of an end gate in which a vertically swinging end gate is provided with oppositely extending bails that limit the lateral extension of the two retaining wings or members, and permit of the folding of the members against the end gate when the end gate is closed.

BELT GUIDING DEVICE.—R. H WEATHERSBY and W. B. CLARK, Mammoth, Ariz. The invention relates to an attachment for vehicles, particularly driven vehicles, and is in the nature of an improved belt guiding device forming part of a belt traction device for use in sections of the country where loose, sandy soil is predominant and the vehicles retarded as a consequence thereof.

## NEW BOOKS, ETC.

AMERICA FALLEN! The Sequel to the European War. By J. Bernard Walker. New York: Dodd, Mead & Co., 1915. 16mo.; 203 pp.; 5 plates. Price, 75 cents.

In this book the naval and military unpreparedness of the United States is demonstrated in the form of a dramatic narrative, which shows how helpless this country would be against a sudden and carefully-planned attack by a first-class naval and military European power. The naval and military disasters depicted in this story are based upon the warnings which, year after year, have been given in the annual reports of our leading naval and military authorities, and in the reports of the Secretary of War and the Secretary of the Navy. The European war ends favorably to the Allies in the spring of 1916, when Holland declares war and a powerful allied army invades Germany, crossing the German frontier to the east of the Rhine and capturing the great sources of German artillery and ammunition supply in Westphalia. The treaty of peace is signed at Geneva, and Germany, to prevent the disruption of her fleet, agrees to pay an indemnity of 15 billion dollars. In view of the fact that it was largely the munitions of war supplied by the United States that enabled the Allies to win, Germany feels that she is entitled to levy that 15 billion dollars upon this country. She sends her fleet and an expeditionary army of 200,000 veterans of the war to collect the money, and the last ten chapters of "America Fallen" show how swiftly and with what deadly certainty the thing is done. On April 1st, at dawn, one hour after the declaration of war reaches Washington, half a dozen flotillas of the famous German submarines show their periscopes above the water in half a dozen ports, dockyards and naval stations of the United States, and, within half an hour, not a submarine or destroyer of our navy is afloat from Boston to the Panama canal. The same night an advance force of 20,000 men is landed and the forts protecting Boston and New York are taken in reverse. The German dreadnoughts enter the harbors, demand 5 billions ransom from New York and 3 billions from Boston—and get it. Washington is captured and the seat of Government is moved to Pittsburgh. The United States long-distance radio stations are captured, and the German Intelligence Service having become possessed of the navy secret code, our fleet of 10 dreadnoughts at Vera Cruz is lured to Cuba, met there by a fleet of 22 German dreadnoughts, and the battle of the Caribbean, the greatest sea fight in history, is fought. The great German transports bring over and land at Boston, New York and Philadelphia a force of 200,000 picked veterans of the European war, who within a few days of the declaration of war take possession of every arsenal, gun, rifle and powder factory east of the Alleghanies. The American forces (70,000 effectives) are withdrawn to Pittsburgh, and near this city, on the historic ground at Braddock, they are overwhelmed by a German army of 150,000 men, whose artillery, four times the strength of that hastily gathered by the defense, decimates our gallant forces. Pittsburgh is evacuated and the seat of Government is removed to Cincinnati. Here, acting on the advice of its naval and military chiefs that it would take from three to six years to build the factories and construct the guns and equipment necessary to equip the millions of volunteers and get them into such shape as to ensure the driving of the millions of the German army of occupation back to the sea, the Government decides to pay the indemnity demanded and "write it off on the National Ledger as the cost of being taught the great national duty of military preparedness." This work may not please but it will certainly fascinate the American reader. If he reads the first chapter, probably he will not put the book down until he has read the last.

THE "SHIPPING WORLD" YEAR BOOK. A Desk Manual in Trade, Commerce, and Navigation. Edited by Evan Rowland Jones. London: The *Shipping World* Offices, 1915. 8vo.; 2,004 pp.; with new map of the world. Price, in the United Kingdom, 10s. net; in other countries, 11s.

The familiar green cover with its Ethiopic Neptune and his ebon nymphs reminds us of former annual meetings with our old friend, "The *Shipping World* Year Book." It presents the usual complete port and harbor directory of the British Isles, and of commercial ports of the world. The "tariffs of all nations" includes the new Colombian tariff; this section is somewhat affected by the war, to the extent that the tariffs of Germany, Austria-Hungary and Turkey could not be revised to date. Important new legislation affecting shipping is given. Among other new or revised features are the list of radio stations of the British Isles, an abstract of the Suez Canal Regulations, and the shipbuilding and shipping bounties and subsidies of foreign countries. There is a new map of the steamship and railway routes of the world, showing the ports, coaling stations and coalfields of all countries.

L'ACETILENE. E De Sue Pratiche Applicazioni. Illuminazione: Riscaldamento: Saldatura Autogena: E Taglio Rapido Dei Metalli: Legislazione, Ecc. L. Castellani e U. Romanelli. Milano: Ulrico Hoepli, 1915. 16mo.; 355 pp.; 115 illustrations. Price, L. 4.

This is a treatise quite characteristic of the Hoepli library, condensed, yet thoroughly practical. It deals with acetylene in its various applications, and it is not especially difficult reading for students of the Italian language. Illumination, heating, autogenous welding, and cutting, are all treated of, and the legal restrictions governing the production and use of the gas are given. Small as the treatise is, it is well and adequately illustrated.

## LEGAL NOTICES



## Classified Advertisements

## Panama Hats

(*Concluded from page 456.*)

it up to the light and look through it to see whether or not there are any knots or patched places in it. Sometimes in making them the strands are broken and additional ones have to be woven in. This spoils the texture, although it is not noticeable in a cursory examination of a new hat. When the hat has been worn such ends are inclined to stick up and ruin the appearance of the Panama.

A good Panama hat will withstand the roughest kind of usage. It is an ideal protection for the head from both sun and rain. It may be subjected to all sorts of indignities, but the one so often inflicted on it here in the United States, and that is bleaching it with acids when all it requires is a careful washing in warm water assisted by a generous lather of Castile soap. Do not fear to wash it as often as you wish. Have the water warm, not hot, and use all the soap necessary. If possible, dry it on a block, but if no block is available, stuff it with paper or cloth and dry it in the sun. The only bleaching a Panama hat can stand is sun-bleaching. The fine straws crack and break within a few days after they have received an oxalic acid bath.

## Edison Submarine Boat Storage Battery

(*Concluded from page 450.*)

lead placed directly on the keel of the craft, to afford increased stability and safety. Furthermore, the Edison battery is more durable, and it is not damaged by prolonged or oft-repeated over-charging, and it may be charged and recharged to full capacity without affecting its useful life, its life not depending upon the number of cycles of charge and discharge, but on a period of time, four years figuring in the present guarantee of the manufacturers. The Edison battery can remain charged, semi-charged, or totally discharged for indefinite periods without injury, and consequently it is not necessary to operate the engine and generators, as in the case of the older types of cells, which require constant attention for forming or correcting the plates. In other words, and what is important on the military side, it is always ready for instant use. The electrolyte contains no acid, and whatever chlorine gas is generated, through the decomposition of saltwater by electric current, immediately becomes iron chloride through the affinity of that metal for chlorine. This is due to the large amount of iron present in the steel jars, as well as in the plates of the cell. The Edison battery does not shed its active material, nor is it affected by the continued and oft-repeated short-circuiting. There is no necessity to take the cells apart or to remove any sediment, which in the case of a lead-sulphuric acid battery for a submarine may amount to from 7,000 to 12,0000 pounds, and materially affect its trim. There is no danger of the accumulation of gas, as in the top of each Edison cell there is a water-trap which forms an effective seal, and should there be a sufficient accumulation of hydrogen and oxygen in any single cell, sufficient to produce an explosion, the steel jar possesses sufficient strength to resist it, while the water-trap prevents any fire within the cell from reaching the exterior. No specific gravity readings are necessary oftener than one about every six months, to determine when it is necessary to renew the solution. The electrolyte used in the Edison cell not only preserves, instead of corroding the steel, but it also absorbs the carbonic acid gas exhaled by the crew, for there is sufficient potash to absorb all the $CO_2$ thus given off for 100 days. In this process no harm is done to the battery and the carbonic acid gas may be removed from the electrolyte when opportunity arises after a protracted submerged run.

Comparing the Edison battery with a lead battery to be used under similar conditions in a submarine, a typical installation of the former has a capacity of 910 kilowatt hours when discharged in three hours. In the same number of cubic feet, and with a saving of about 1,600 pounds in weight, an Edison storage battery will

be installed which will have a capacity of 1,212 kilowatt-hours when discharged at the three hour rate, after a normal charge, and 1,347 kilowatt-hours when discharged at the three hour rate after an overcharge. These Edison cells have been tested for rough usage under extraordinary conditions of vibration, oscillation, bumping, overcharge, short circuit, etc., and it is expected that the good features already shown, will develop also in actual service; thus increasing the efficiency and radius of action of the submarine.

## Power of Mind in Baseball

**By Arthur Macdonald**

THERE are three general mental states in which a ball player may be; overconfidence, lack of confidence, or nervousness. Overconfidence can cause a player to make an error through want of sufficient effort. Thus a good fielder will muff an easy fly to the surprise of everyone, including himself. The ball may have been twirling more than usual, but he was in a relaxed condition, and his grasp, as a result, was not as quick and strong as usual. It is doubtful if any major league player has any lack of confidence in catching a fly if he can get to it with reasonable effort.

Lack of confidence comes to the batter when puzzled by the pitcher, or when he is thinking of the pitcher's great reputation. Nervousness is the worst condition of all, for even the best players when in such a state may play the worst.

Stanage, a great catcher, says, "Catching demands one third ability and two thirds mental work." Edward Collins states that grounders do not come as hard to second base as to first or third, "but when it comes to the other part of the game, the thinking part, second base becomes a difficult position. Baseball games are won in many instances because players think quickly." Collins was on first, the batter had three balls and no strikes, and nobody was out, yet he stole second base, and was severely criticised. But as no one believed he would try to steal under such conditions, he felt sure he would succeed by doing the unexpected. Coombs says next to control in pitching comes head work.

Frank Chance holds that "confidence is half the battle in baseball." It is certainly one of the greatest mental forces in the game. Thus a weak team that has been winning is harder to beat than a strong team which is losing. A fresh young pitcher is more difficult to hit than an experienced one who is uncertain of himself. One team is helpless before a pitcher that a weaker team pounds all over the field. A batter is unable to make a base hit on one pitcher, yet can hit the same kind of ball from another pitcher. There are not a few players retired or returned to minor leagues who have lost confidence in themselves.

A base on balls is better than a hit, because it may affect the pitcher more and tend to lessen the confidence of the team.

Joe Tinker, an ordinary batter, was convinced he could hit Mathewson, the great pitcher, and Mathewson seemed to have the same belief, for Tinker won five games from New York by his individual batting in one season.

When a pitcher hits a batter, it may discourage his side and destroy confidence in him. When a player has a quarrel with another or with the umpire, I have noticed that he is liable to be upset in his playing as well. Many important physical movements are unconscious, but when a player becomes irritated his nervous system is easily thrown out of gear, and this unconscious action is affected.

When the first batter up is retired half the inning is over. The mental state produced by this bad beginning is probably the cause. Nearly every baseball game is decided by one play at the psychological moment, which is called the "break." Why a weak team will beat a strong team and be beaten by another weak team with regularity, are mental problems.

An unexpected hit may flurry the pitcher and make him pitch badly to the next batter, and the game may be lost.

The failures of some fielders to hit can worry them much and make their fielding bad also.

The crowd may affect the umpires, who are popular in one town and disliked in another. In certain cities the weakest umpires succeed best, because they yield to the clamoring of the crowd in close decisions.

I have noticed that when a fielder fumbles a ball he is more liable to make a bad throw, especially if the fumble is inexcusable. The cause of this may be that, experiencing disappointment or shame, he feels desperate, and throws accordingly.

It is unfortunate to have the idea that a pitcher is hard to hit, no matter how true it may be; for if the batter did not have this idea, the pitcher would be easier to hit. An illustration is the case of Walter Johnson, who for an unusual number of games defied the batters of many different teams, until he was suddenly hit hard by the Cleveland team. Johnson claimed he was in the best of form and pitched as good as he ever did, and his claim was doubtless true. But it was the psychological condition of the Cleveland batters that made the difference. As soon as batters become confident that they can hit a pitcher, even if they fan occasionally, they are very liable to hit any pitcher as long as they persist in such a mental attitude. The great reputation of a pitcher in the minds of many batters may be a strong factor in preventing him from being hit. When one fears he cannot hit the pitcher (he should banish such feelings), if he fouls the ball, this tends to give him confidence, that he can at least hit it somewhere; whereas if he strikes out, his fear may be increased. Rallying may be explained in a similar way. A good hit raises hope in the next batter and there is a rush; this mental state may also be produced on the home grounds by systematic and rhythmic encouragement (clapping) of the crowd. The lucky seventh inning sometimes shows the result of this. The rally at batting occurs, notwithstanding the fact that the pitcher who could not be hit before the rally is often pitching just as well as ever. It may be the mental condition of the batter that has changed, rather than the pitching of the pitcher. On the other hand, the batting rally itself may cause the pitcher to lose confidence and pitch badly.—Abstracted from *American Physical Education Review.*

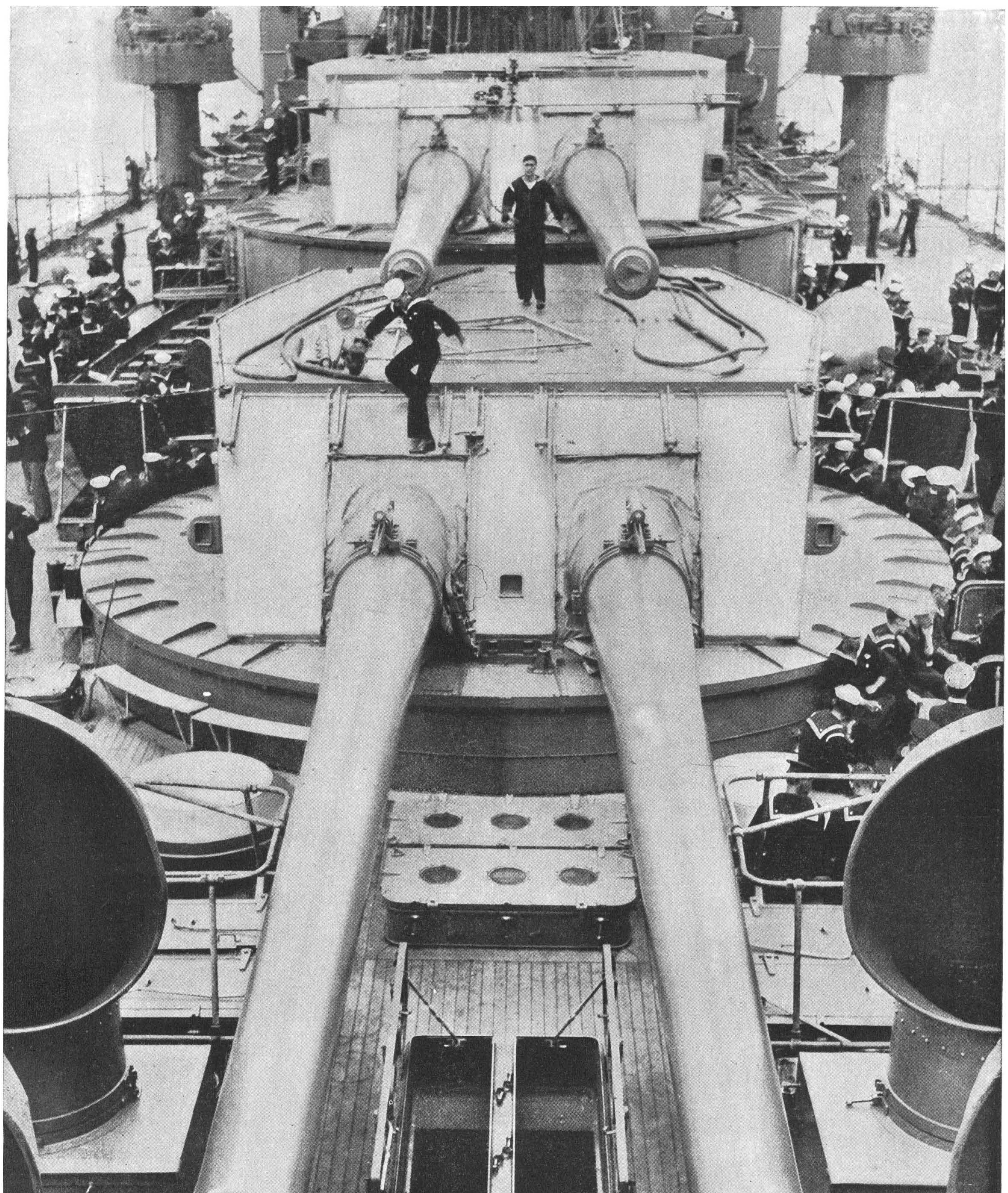
### A Study of Coral Reefs

During most of the year 1914 Prof. W. M. Davis of Harvard University was occupied in visiting and studying islands in the Pacific Ocean with the object of testing the various hypotheses that have been proposed to account for the formation of coral reefs. The problem is an old one, but has been the subject of especially active discussion in recent years. In an account of his investigations just published Prof. Davis, after reviewing various other attempted explanations, states that Darwin's simple theory of subsidence is the only one that appears to account satisfactorily for the formations he has visited. This theory assumes a slowly subsiding ocean bottom, as a result of which the islands gradually sink, diminish in size, and eventually disappear, while the fringing coral reefs grow upward and are converted into barrier reefs and atolls.

### Reinforced Concrete Work in Egypt

A remarkable piece of reinforced concrete work is the jetty at the port of Alexandria, Egypt. The entire construction has a total length of 330 feet, and is made up of a series of caissons in reinforced concrete which are floated into place in the sea. Such caissons are 5 in number and measure 66 feet long by 26 feet wide and 20 to 22 feet high, and are built on the Hennebique system. Caissons are let down a slipway into the water, and one or more steam tugs serve to tow them into place, where they are let down on the prepared bed of the sea. Concerning recent work in Egypt we may also mention an embankment wall on the Nile at Ghesireh which was very successfully carried out.

# SCIENTIFIC AMERICAN



Copyright by Underwood & Underwood 1915

FORWARD DECK OF FLAGSHIP "WYOMING," SHOWING THE 12-INCH GUNS OF TURRETS NO. 1 AND NO. 2.—[See page 473.]

Vol. CXII. No. 21
May 22, 1915

Munn & Co., Inc., Publishers
New York, N. Y.

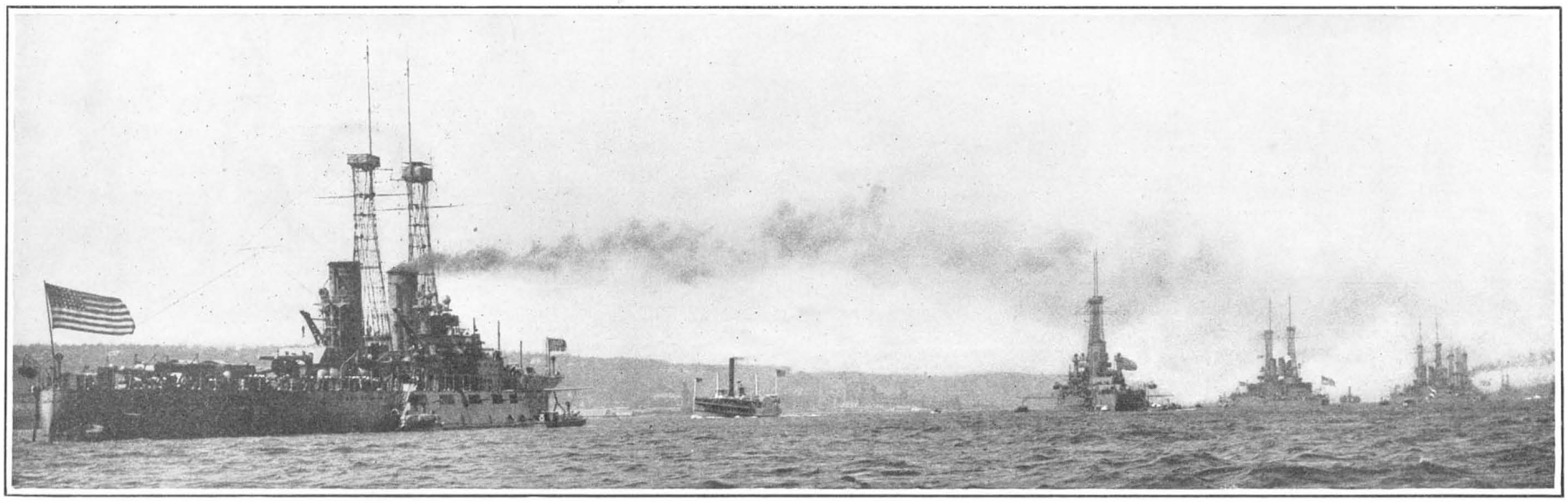
Price 10 Cents
$3.00 A Year

SEVENTY-FIRST YEAR

# SCIENTIFIC AMERICAN

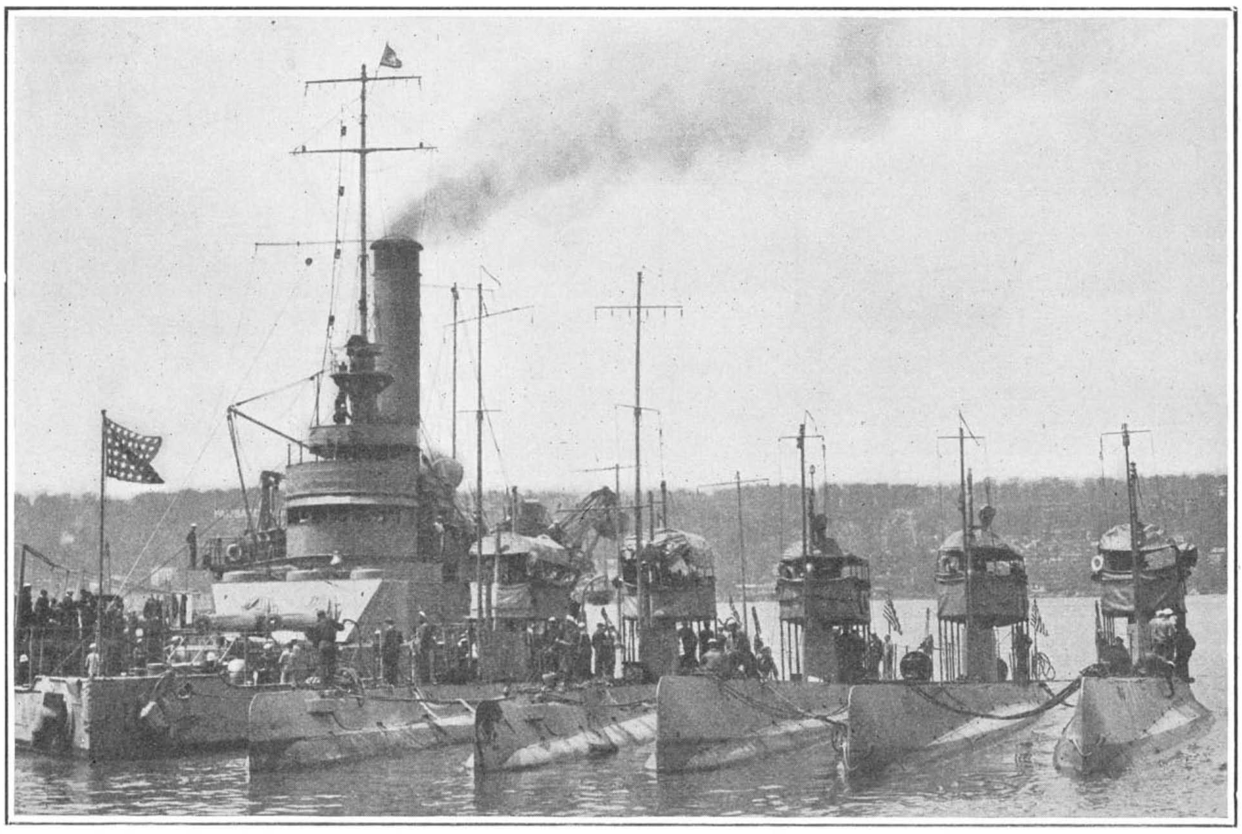
THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

VOLUME CXII. NUMBER 21. NEW YORK, MAY 22, 1915 10 CENTS A COPY $3.00 A YEAR

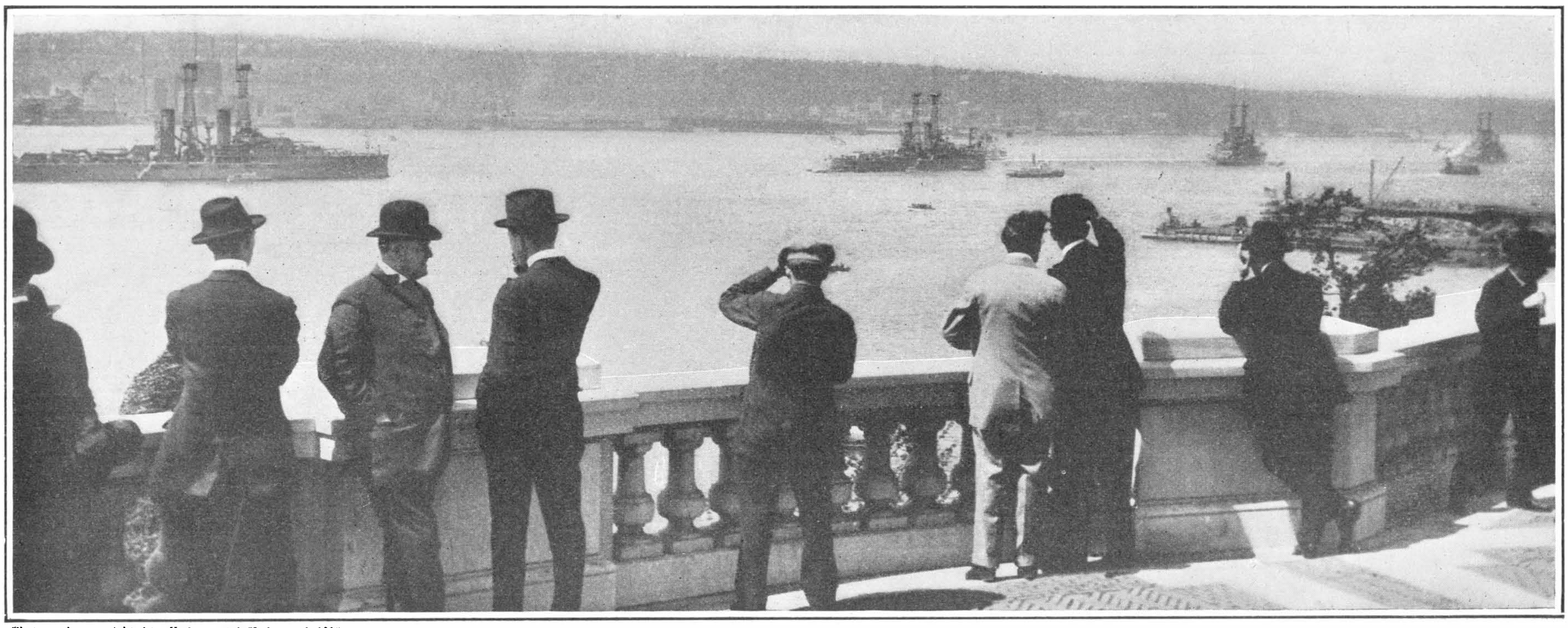


The fleet in the North River, with U. S. S. "Delaware" in the foreground.

Admiral Fletcher.



Monitor "Tonopah" and group of five submarines.



Photographs copyrighted by Underwood & Underwood, 1915.

The fleet as viewed from the Soldiers' and Sailors' Monument.

THE NAVAL REVIEW IN THE HUDSON RIVER, NEW YORK

# SCIENTIFIC AMERICAN

**Founded 1845**

**NEW YORK, SATURDAY, MAY 22, 1915**

Published by Munn & Co., Incorporated. Charles Allen Munn, President; Frederick Converse Beach, Secretary; Orson D. Munn, Treasurer; all at 233 Broadway, New York.

Entered at the Post Office of New York, N. Y., as Second Class Matter
Entered as Second Class Matter at the Post Office Department, Canada.
Trade Mark Registered in the United States Patent Office



**Subscription Rates**

| | |
|---|---|
| Subscription one year........................................... | $3.00 |
| Postage prepaid in United States and possessions, Mexico, Cuba, and Panama. | |
| Subscriptions for Foreign Countries, one year, postage prepaid, | 4.50 |
| Subscriptions for Canada, one year, postage prepaid.......... | 3.75 |

**The Scientific American Publications**

| | |
|---|---|
| Scientific American (established 1845)................per year | $3.00 |
| Scientific American Supplement (established 1876).... " " | 5.00 |
| American Homes and Gardens......................... " " | 3.00 |

The combined subscription rates and rates to foreign countries including Canada, will be furnished upon application.

Remit by postal or express money order, bank draft or check.

**Munn & Co., Inc., 233 Broadway, New York**

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp* the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

*The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.*


## War, Humanized and De-humanized

ONE of the most assuring evidences of the fact that the world has been steadily advancing toward a higher civilization has been the development of a set of laws designed to soften, if not eradicate, the inhumanity of war. War is a professional business. The soldier is the professional exponent of war. It is his business to kill and, if fate so decrees, to be killed. But all around the inherent terror and cruelty of war, there has been built up, by the common consent of civilization, a series of restrictions designed to protect, as far as may be, the non-combatants. It is one of the most lamentable features of the present struggle that by one nation, at least, these safeguards have been ruthlessly thrown aside.

The sinking, on sight, of the "Lusitania" is the latest and most atrocious instance of this relapse to that gratuitous cruelty which we all thought had been relegated to a bygone and far-distant age.

There are two features which render this crime peculiarly abhorrent to the civilized world: The first is its magnitude; the other is the cold-blooded premeditation and careful deliberation with which it was planned.

One of the most remarkable psychological phenomena of the present war is the specious sophistry with which Germany has attempted to justify her multitudinous breaches of the above-mentioned humanitarian laws of war; and surely the most amazing instance of this is the fact that to-day, at this very hour, Germany is justifying this slaughter of innocent non-combatants by stating that she gave them full warning that she was going to perpetrate the deed. This is a new philosophy, indeed! Our laws in America have never considered that, because a gunman gave warning to a citizen that he was armed and was going to shoot him on sight, the slayer was thereby absolved from all responsibility. On the contrary, such warning is considered by the law as evidence of criminal intent.

We pointed out in a previous issue that for a blockade to be lawful it must be effective, and that to be effective it must be so complete that practically every ship of the enemy is estopped from entering or leaving his ports. But what are the facts? Since this so-called submarine blockade has been attempted, only one ship out of every two hundred and fifty entering and leaving British ports has been torpedoed. The blockade, therefore, is an utter farce, and hence, the sinking of the "Lusitania" under the existing conditions and the blotting out of the lives of her passengers is an act that is outside of the pale of legitimate warfare. At the bar of modern civilization, "the deep damnation of their taking off" will forever be written down as an act of unrelieved and most cruel murder.

We protested editorially in our last issue against the use of the phrase "war is war" to cover the inhuman violation of the rules of war of which the sinking of the "Lusitania" is the climax. There is such a thing as chivalry in war—it is even possible, if one has to fight, to fight like a gentleman. There is a sense in which it can be said that war is a trial of strength and skill, governed by certain rules of the game, and that in this sense the contest, in spite of its attendant horrors, can be carried on with a certain self-restraint and nobility of spirit which, so far as may be, will rob it of some of its degradation. When it is said that every soldier should be "sportsmanlike," that statement carries an instant conviction to every member of that great Anglo-Celtic race which constitutes at once the backbone and the vast majority of the American people.

Can it be that the Teutonic mind thinks otherwise? If, when two German students were facing each other for the sword contest, one of them suddenly threw his left hand forward and squirted vitriol into the eyes of his opponent, and then cut the blinded man's face to ribbons, would the body of German students applaud the act as an exhibition of ingenuity, forethought, and fighting efficiency?

When the German Grand General Staff, finding it could not break the allied line at Ypres by the legitimate methods of warfare, started to blind and suffocate the enemy with poisonous gases, is it possible that they did not know that the whole world outside of Germany (and, pray God, some inside of Germany) would denounce the trick as unfair, unchivalrous, and a relapse to long-abandoned methods of warfare—to the "Greek fire" of the ancients, or, if you will, the "stink-pot" of the Chinaman?

Again, when the German navy found itself swept from the high seas and shut up in its ports; when it realized, after its initial successes, that its submarines could do no serious hurt to the warships of the enemy, was that any justification for its trampling on the humanitarian laws of war, and proceeding, in its baffled rage and fury, to sink the non-combatant merchant ships of the enemy, without even giving the passengers and crew a chance for their lives?

Germany, through the German Foreign Office, has confessed its guilt by saying that which it knows to be untrue regarding the "Lusitania." It speaks of the "Lusitania's" "armament" — although its Intelligence Service long ago informed it that the "Lusitania" was unarmed—a fact which Collector Malone of the Port of New York has verified in an authorized interview.

As the French would say: *"Qui s'excuse, s'accuse."*

## The Renewing of Italy's Navy

THE Italian navy of to-day is experiencing a period of vigorous renewal. The war in Libya, far from determining the interval of inactivity which so often follows a war, impelled Italy to fresh efforts and greater speed in her naval constructions; four dreadnoughts have already taken their place in the fleet, two others are about ready to enter into service, and four super-dreadnoughts are already in the initial stages.

The first dreadnought of the Italian navy was the "Dante Alighieri" armed with twelve 12-inch guns situated in four triple turrets.

After the "Dante Alighieri" came the "Giulio Cæsare" and two others of her type, the "Leonardo da Vinci" and the "Conte di Cavour," all three of which have thirteen 12-inch guns instead of the twelve guns of the "Dante Alighieri." The dreadnoughts of the "Giulio Cæsare" type in the trial of their artillery gave most satisfactory results.

The plans of the "Leonardo da Vinci" and her two sister ships were the work of Edoardo Masdea, whose early demise was a grave loss to Italian navy engineering, he having designed more than one half of the Italian fleet.

The principal characteristics of the three dreadnoughts of the "Guilio Cæsare" type are as follows: Length over all, 533 feet; beam width, 83 feet; displacement, 22,700 tons; speed, 22 knots. The principal battery consists of thirteen 12-inch guns, situated in three triple turrets and two twin turrets. The secondary battery is composed of eighteen 5-inch guns in casemates placed within armored bridge-houses, twenty 3-inch guns, and three torpedo tubes. The armor protection consists of a complete armor belt about 10 inches thick, tapering at the stern and diminishing in thickness toward the upper part. The motive power is furnished by Parsons turbines, capable of developing 24,000 horse-power. There is a normal fuel supply of 1,000 tons, and reserve bunkers with a capacity of another 1,500 tons.

Two other dreadnoughts of nearly the same type as the "Giulio Cæsare" are the "Doria" and the "Duilio," launched over three years ago, and now practically completed. The displacement and principal battery are the same, but the secondary battery is composed of 6-inch guns instead of the 5-inch guns of the "Giulio Cæsare." These two sister ships are the work of the government shipyards of Spezia and Castellamare di Stabia.

From dreadnoughts, Italy has progressed conclusively to super-dreadnoughts. As the SCIENTIFIC AMERICAN has noted in its columns, the Italian navy shows much foresight in all that pertains to possible developments in naval artillery. With these new ships—three in number—she has passed abruptly from the 12-inch gun to the 15-inch gun, without touching the intermediary caliber. Although Italy was the first to introduce triple turrets in the navy, in her new super-dreadnoughts there is a return to twin turrets.

The super-dreadnoughts, one of which will bear a name of common interest to Italy and to the United States, that of "Christoforo Colombo," will have a displacement of 32,000 tons and will be armed with eight 15-inch guns and eighteen 6-inch guns. The contract speed is 25 knots, but it is strongly hoped to increase this to 28 knots.

The great displacement of the super-dreadnoughts is owing to their high speed and heavy protection, the ship's bottom also being protected against explosions under water. It is maintained that no foreign battleship of corresponding type and period will be able to compete with this new ship in armor protection, and she is expected to sustain the reputation of the Italian navy for devoting especial attention to the problem of highest speed. This new type of ship is the work of Edgardo Ferrati, who succeeded Edoardo Masdea in the direction of the Corps of Italian Naval Engineering.

Following on the new super-dreadnought, studies will be initiated for the still greater battleship of the future, and the result will undoubtedly be a fresh achievement of Italian naval engineers, pioneers in resolving the most arduous problems of naval engineering and artillery. It should be remembered that the dreadnought type had its genesis in Italy in the "Vittorio Emanuele" type, and its precursors in the "Duilio" type of forty years ago. The SCIENTIFIC AMERICAN, in an article published recently on the subject of the "Texas," recalled the fact that between 1880 and 1890 the Italian navy constructed the "Lepanto" and the "Italia," of 16,000 tons displacement, armed with four 17-inch guns and with a speed of 18 knots; in 1888 Italy armed the "Re Umberto" type with four 14-inch guns.

After all, allowing naturally for thirty years' progress in engineering and naval artillery, the super-dreadnought is but a return to those first conceptions which at the time seemed almost sheer folly, but which now justly impose themselves on the navies of the world.

The Italian navy, seconded by the enthusiasm of a people that never seek to evade or refuse an appeal for the national defense, has won back her place in the Mediterranean, that classic Latin sea, of which she was once conqueror and possessor. No longer ambitious for dominion or possession, Italy intends only to hold her place with dignity and firmness in that sea which bathes her coast for more than 1,200 miles, and laps the shores of Libya, her new colonial possession.

## Disease in Warfare

PROBABLY few other than medical observers realize fully the part disease is playing during the present world war, and will continue to play, when the war is done, by reason of the predispositions brought about by war's stresses. Although the medical military service is probably more perfected than in previous conflicts, yet several men are dying of disease to one slain by ordnance. Infection has indeed modified the course of all, and has abruptly terminated some wars. Campaigns which should by all military prognostications have succeeded, have failed because cholera, plague, typhoid, typhus, small-pox, malaria, dysentery, and yellow fever have cheated shot and shell of their victims. Montgomery and Arnold were not successful in invading Canada because too few were left for the assault when small-pox and dysentery had taken their quota. Napoleon in 1802 wanted to found an empire in our South, and could not because the San Domingan epidemics outgeneraled him, destroying 15,000 of his fine army. In our Mexican war less than 1,000 were killed or died of wounds, while nearly five thousand succumbed to the bacterial bullet. The British in the Crimea lost twenty-five men from disease to one from wounds. In the Franco-Prussian war Bazaine's great army, if it had not surrendered at Metz, must have succumbed utterly to disease and starvation, while literally one half the investing Germans, with everything in their favor, were on the sick list. In the brief war with Spain, our dead from sickness were seven times more numerous than from injury. In the Balkan war of several years ago the Bulgarian campaign broke down largely because of epidemics. There were 30,000 cases of cholera in one day. Here was a more fatal factor than the Turkish resistance in checking the Bulgars at Chatalja.

And war's aftermath. The unusual physical stresses of war, and the enduring effect of its horrors upon the psychism, predispose to degenerations and organic diseases. Wherefore there is in the few years after every war unusual sickness and untimely death among the survivors, from anemia, debility, liver, heart, kidney and other diseases. Tuberculosis has long manifested itself in its insidious and malign way, in the world's large armies. Many enlisted men have this disease latent in them, either to burst forth under the strains of campaigning, or to appear soon after the exhausting warfare is ended. Thus, when one computes the awful life destruction in war's carnage, one must multiply that loss several fold by reason of disease.

## Science

**The University of Pennsylvania Amazon Expedition** has made another journey into the unknown, and is now exploring the frontier regions of Brazil, Peru, and Bolivia. The expedition expects to spend six months in that region and to return to civilization at Para.

**Cameras in the Stomach.**—The production of cameras sufficiently small to be swallowed and constructed to photograph the interior of the stomach is referred to in current publications, U. S. patent No. 619,792, issued February 21st, 1899, for the subject and included illuminating means, and a number of German patents have been issued for camera apparatus adapted for this purpose.

**Liberating Caged Birds.**—Writing on this subject in *Bird Notes and News*, Mr. W. H. Hudson mentions the common idea that a caged bird when liberated is speedily set upon and ill-treated by wild birds. It appears that the Royal Society for the Protection of Birds receives many letters of inquiry on this subject from persons who would like to pursue the humane hobby of freeing birds from captivity. The writer mentions several observations of his own and of others which appear to show that there is no truth in the popular notion.

**Mr. Walter G. Davis,** the veteran North American director of the Argentine Meteorological Service, recently retired on a pension, and was succeeded by Señor Martin Gil, described in the Argentine newspapers as a wealthy amateur meteorologist and astronomer, much interested in long-range weather prediction. Argentina has for many years possessed the only national meteorological service comparable in scope and efficiency to those of the principal European countries and the United States. Its future will be watched with much interest.

**Lead Poisoning in Storage Battery Factories.**—A bulletin recently issued by the U. S. Bureau of Labor Statistics shows that lead poisoning is far too prevalent in the storage battery factories of the United States. While in the largest factory of this kind in Germany the rate of lead poisoning is less than 1 per 100 employees, and in Great Britain about 3 in 100, in the five largest factories in this country the rate, based on reports known to be incomplete, is almost 18 per 100. The difference is said to be due to the neglect in the United States of factory sanitation and of personal care of the men employed. The bulletin in question points out the sources of danger and the best means of minimizing the same.

**Mosquito-destroying Solutions** have been the subject of recent extensive investigations in Germany with reference to their effects on aquatic animals and birds. It is found that petroleum has no poisonous effect upon the lower animals living in the water, while the soluble components of saprol, carbolic-free saprol, larviol A, and larviol B kill all creatures living in the water down to a certain depth (many times greater in the case of saprol than in that of larviol). The most destructive of these substances, however, have no more lasting effect upon the lower forms of aquatic life than the natural drying up of stagnant ponds. On the other hand, it is claimed that water covered with a layer of any of the substances above named does no harm to native birds, game or domestic animals that may happen to drink of it.

**Robusta Coffee** is recommended by P. J. Wester, in the *Philippine Agricultural Review*, for the rehabilitation of the coffee industry in the Philippines, where, as elsewhere in the eastern hemisphere, the industry received a serious setback from the coffee blight. Robusta coffee, also known as Congo coffee, and believed by Wildeman to be a variety of *Coffea canephora*, was discovered in the Belgian Congo, and seeds were sent to Brussels, where plants were first offered for sale in 1901. It soon found its way to Java, and to-day the Javanese plantations consist almost entirely of this variety. The annual crop increased from 183,000 kilogrammes in 1909 to about 16,000,000 in 1912. While not immune from blight, it grows well and produces abundant crops notwithstanding the presence of the blight. The Philippine Bureau of Agriculture is now distributing seed imported from Java.

**The Term "Indian Summer."**—The origin of this expression, like that of the word "blizzard," has been the subject of much research. It has been traced back only as far as the latter part of the eighteenth century, and it did not become common until after the first decade of the nineteenth. Many explanations of the name have been offered, all of which assume that the term "Indian" used in this connection refers to the American Indians. A recent note in the *Monthly Weather Review* calls attention to a totally different use of this term, in which the reference is not to the American Indians, but to East India. Under the British Board of Trade Regulations, one of the load-lines marked on ships bears the initials "I.S.," this being the maximum depth to which vessels can be loaded for voyages during the "Indian summer," i. e., the fine season in the Indian seas. How long has the term "Indian summer been used in this sense? It is not recorded in any dictionary, nor, apparently, in any work on meteorology. Is it possible that our autumnal Indian summer was so named by sailors or travelers who saw in it a resemblance to the fine weather attending the northeast monsoon in India?

## Automobile

**Around Cape Cod by Motor Car.**—An extensive automobile passenger service will be maintained this summer running from Boston to Provincetown on the tip of Cape Cod. The route will go from Boston, via Brockton, Middleborough, Wareham, Buzzards Bay, Woods Hole, Hyannis, Chatham, Orleans to Provincetown. The line is to be covered by motorbuses, running on the five-cent unit fare plan, with fare pay stations at fairly generous intervals.

**Pump, Fan and Horn Combined.**—The tendency of automobile manufacturers, for reasons of economy and simplicity, to combine several of the accessories in a single unit, has resulted in a further interesting combination, namely a horn-pump-fan unit. The fan-horn was recently described in the SCIENTIFIC AMERICAN, and now there has been added a power driven air pump. The triple combination may be attached to any car, without additional machine work. The pump is of the single air-cooled cylinder type, 1½-inch bore by 1¾-inch stroke, of gray cast iron.

**Electric Vulcanizer with Thermometer.**—One of the reasons why steam vulcanizers for motorists' use have proven so popular is the fact that they cannot easily be overheated. One of the new electric vulcanizing devices brought out by an American manufacturer includes a thermometer in the heating plate. When the temperature rises above 275 degrees, the current should be turned off. The vulcanizer itself consists of a U-shaped piece holding on its two ends the vulcanizing plate and an opposition plate, the rubber being inserted between the two plates.

**Motorcars Are Now Everywhere.**—The last two strongholds of "anti-motorists" have finally succumbed, and the automobile is now admitted into every nook and cranny of the United States. The last barriers to fall will be those of the Yellowstone National Park, which is scheduled to open for the motorists on August 1st. On April 25th, of this year, Bar Harbor, Me., and Mt. Desert, opened their roads to the hated motor car. At the last session of the Legislature a bill was passed, admitting automobiles on the island, the popular summer resort on the Maine coast.

**An Oilcan With Bellows.**—"Why hasn't somebody thought of this before?" That is the involuntary exclamation of everyone who has had an opportunity of viewing the latest development in the line of oilcans—namely, an oilcan with bellows. Ordinarily the bottom of the oilcan of commerce has but a movement through a small fraction of an inch, and this small motion is relied upon to force the oil through the narrow opening at the top. A new oilcan, however, has just appeared on the market which has a metal bellows as oil container, which is held extended by a small spring. Pressure upon the bottom of the can forces the bellows together and the bottom of the can upward, with the result that a strong and steady stream of oil can be injected where desirable.

**Ball Bearing Imports.**—One of the most puzzling features of the import statistics is undoubtedly the continued strength in ball bearings, imported from Germany. The majority of the imported ball bearings come from the land of the Kaiser, and despite the embargo which is known to have been declared by the German government on anti-friction bearings, and the complete throttling of commerce from German ports, imports of ball bearings in February of this year were higher than in the same month of 1914. Importers say that all the bearings sent to this country at the present time have been manufactured in the Italian branch plants of the larger German companies, or have been shipped quietly via Italy. The value of imported ball bearings in February was $197,842.

**Speedometer for Speed Control.**—Speedometers, as a rule, only tell the motorist when he is exceeding the speed limit; they do not prevent him from doing so. On commercial motor vehicles, the speed question is often of greater importance than that of overloading, and one of the large speedometer manufacturers has hit upon the happy idea of combining the indicator of speed with an arrangement that will prevent the driver from going faster than the device has been set for. The device consists of a Yale lock, which can be set at any desired speed from zero to 60 miles an hour. When the indicated speed is reached by the speedometer hand, an electric contact is established which energizes a magnet contained in a small box, through which the rod from the carbureter throttle passes. This rod is split within the case and one end passes freely in a sleeve fitting tightly over the other end of the rod. Normally, connection between the two is made by a pin that passes through an opening in the sleeve and free end of the rod. The closing of the electric contact when the speed limit is reached lifts this pin out of engagement and breaks the connection between the rod and the sleeve. The throttle thereupon closes slowly of its own weight, and no amount of manipulation of hand or foot control will be communicated to the carbureter. When the car has fallen below the speed limit, however, the speedometer contact is released, the magnet permits the pin to fall back into its place and the throttle rod is continuous once more.

## Astronomy

**A Memoir of the Late Sir David Gill** is in preparation. The compiler states that ample material is at hand respecting the late astronomer's public and scientific work, but that notes—narrative, historical, anecdotal or appreciative—in regard to his personality will be gratefully received by Mr. George Forbes, 11 Little College Street, Westminster, London.

**London Skies in War Time.**—One of the many "by-products" of the great war is the opportunity which has of late been enjoyed by astronomers living in and near London to observe the heavens with comparatively little interference due to city lights. At a recent meeting of the British Astronomical Association attention was called to the fact that the zodiacal light had become an easily observed feature of London skies, whereas before the days of Zeppelin raids it was practically invisible to Londoners.

**Saturn Seen Oval With the Naked Eye.**—A correspondent of Mr. E. Walter Maunder, the English astronomer, claims to have frequently seen Saturn distinctly oval with the naked eye during last winter. The position of the rings has been favorable for such an observation during the last three or four years, and it is within the power of strong opera glasses. A naked-eye observation is somewhat questionable. An elongation of the bright image due to astigmatism might explain it. It would be interesting to hear from other keen-eyed observers on this subject.

**Photometry of a Meteor.**—In *Astronomische Nachrichten* No. 4,789, E. Hertzsprung records an interesting study of the fluctuations observed in the brightness of a meteor, the absolute path of which in the atmosphere was known from simultaneous observations at widely separated stations. Through about 15 kilometers of its course the meteor was photographed on a plate near the middle of which were also photographed 56 stars of the Praesepe cluster. These stars, ranging in brightness from the 7.46 to the 10.60 magnitude, furnished the means of very accurate comparison of the meteor's brightness, the variations of which are shown graphically in the article.

**Achievements of the Mount Wilson Observatory.**—No portion of the funds of the Carnegie Institution of Washington has been more fruitfully applied than that which created and has maintained the Mount Wilson Solar Observatory, in California. As Prof. Hale, the director of the observatory, says in his last annual report, he and his colleagues have heretofore devoted a large share of their time to devising and testing methods and apparatus, and these are now being applied to solar investigations which were formerly studied with altogether inadequate means. In a forthcoming book, "Ten Years' Work of a Mountain Observatory," Prof. Hale will outline the results attained during the first decade of experiments and observations. During the year 1914, which began a second decade, many noteworthy results were achieved. A beginning was made in the application to solar phenomena of Stark's capital discovery of the effect of an electric field on radiation. In stellar astronomy discoveries have been made which promise to furnish the means of determining a star's distance simply by measuring its brightness and the relative intensities of certain lines in its spectrum. Spectroscopic studies in the splendid laboratory attached to the observatory have shed new light on astrophysical problems. The report above mentioned enumerates no less than fifty-nine definite achievements as the fruit of a single year's work.

**Electric Furnace Spectra.**—In the elaborate studies of electric furnace spectra which have been made at the Mount Wilson Observatory in connection with solar research problems the latest spectra to be investigated are those of vanadium and chromium. The temperatures used in these studies are classified as low (2,000-2,150 deg. Cent.), medium (2,300-2,350 deg. Cent.), and high (2,500-2,600 deg. Cent.) With vanadium, 2,000 deg. Cent. appears to be about the lower limit for the appearance of a spectrum, though the lines produced at this temperature are fairly numerous. In the case of chromium, the melting-point of which is considerably lower, temperatures between 1,700 and 1,800 deg. Cent. suffice to give a number of the most persistent lines in the spectrum. The variations of these spectra with temperature, together with comparisons between arc and furnace spectra, have recently been described by Arthur S. King. The leading features in the development of the vanadium and chromium spectra are similar to those previously reported for iron and titanium, the vanadium spectrum being very similar to the latter. The chromium spectrum near the temperature at which the vapor begins to radiate shows a predominance of lines which are relatively strong at low temperature and strengthen very slowly with increasing temperature. The extension of the spectra of both elements into the ultra-violet increases as the temperature rises; this has also been observed in the case of iron and titanium. The ability of lines to show self-reversal in the furnace distinctly increases with decreasing wave-length.

## Canada Balsam

THE name balsam, as popularly applied to various vegetable products, is familiar as a household word. The Canada balsam is one of the best known kinds, yet how few persons know anything about the history of this product beyond the fact that it possesses a strong balsamic odor. Canada balsam is a product of the balsam fir tree (*Abies balsamea*) of the northeastern States. Maine, New Hampshire, Vermont, and New York contribute largely toward the annual yield. The name would indicate that it was produced chiefly in Canada, but, although a good deal of balsam is collected in the Provinces of Quebec and Ontario, practically all of the Canada balsam used in the United States is gathered in the State of Maine, where the balsam fir finds its best development.

Canada balsam, known by the gatherers chiefly as gum or balsam, is one of the minor forest products, which is usually not taken into account in calculating the annual returns of the balsam fir forests of a State. In the aggregate more than 5,000 gallons are collected annually in the north woods and a good many families depend upon the collection of this gum as an important part of their requirements for a livelihood.

The method of collecting the balsam is quite unique. Those who are familiar with the balsam fir tree recognize it by its thin, more or less smooth, close, grayish-brown bark marked by numerous projecting resin pockets or blisters. These blisters are filled with a limpid, very transparent and odorous resin which at ordinary temperature flows out freely when the projecting walls of the blisters are ruptured. The balsam gatherers go about from tree to tree rupturing all the resin pockets on the accessible parts of the tree by means of a hollow tube about three eighths of an inch in diameter. The tube is held over the ruptured part of the blister for a few moments until the balsam is all drained through the hollow tube into the can below.

As a rule, entire families of balsam gatherers go into the woods where they camp for two or three months of each year. Their baggage consists chiefly of provisions, a stove, and some bedding. The women remain in camp to do the cooking and to strain the gum; they also transport the gum upon their backs in canisters of five gallons each to the nearest village or store, where it is sold at the rate of about $2 a gallon in exchange for provisions. The men and boys go to pierce the blisters. The boys mount into the branches, while the older men work about the lower part of the tree. A large balsam fir tree rich in gum yields as much as a pound of balsam, but on an average the yield of each tree is not over eight ounces. One man with the help of two sons can gather from sunrise to sunset a gallon of balsam, but the man who works alone has done well when he has collected half a gallon.

Balsam cannot be gathered when it rains, not even on the same day, because the branches are wet and the water dropping into the gum renders it milky and unsaleable. It is collected from June to September or to about the time snow begins to fall or the weather turns cold; the gum does not flow during low temperature. It is sometimes gathered as early as May from trees standing in the open where the sun's rays can strike them. The trees are not worked for two years in succession, because they require two or three years' rest before they can be tapped again, and then they always yield very much less than the first time.

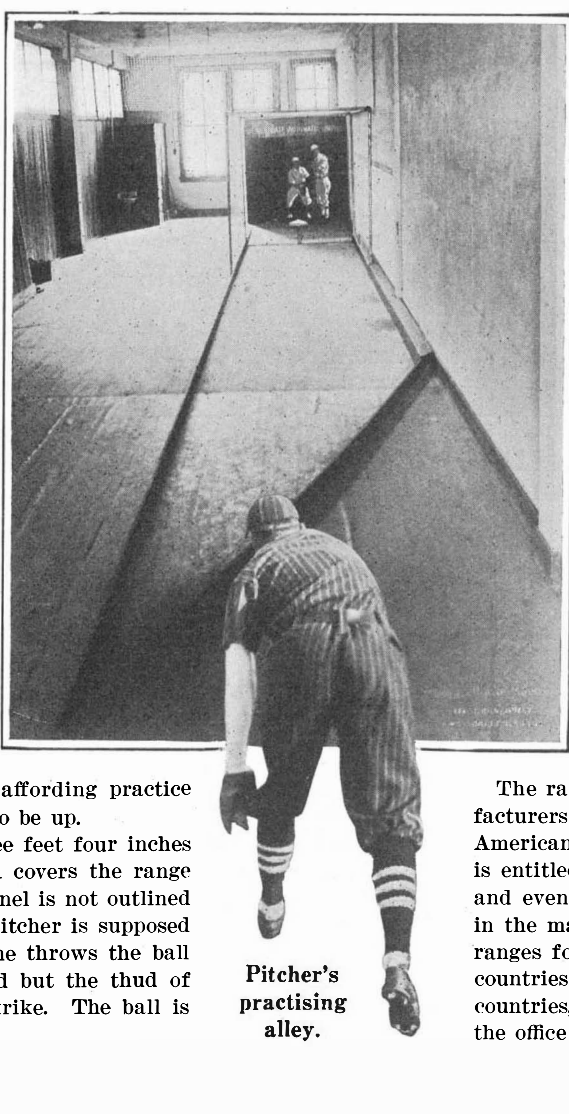
Only the poorest inhabitants and a few of the Indians are engaged in this work. Probably not one of the collectors know what the balsam is used for after it reaches the ultimate consumer. The chief uses of the Canada balsam, after it has been purified by proper straining, are for mounting preparations for the microscope and as a cement for glass in optical work.

## An Electrical Umpire

A DEVICE for electrically registering balls and strikes, and making no mistakes, has been invented by a Los Angeles baseball enthusiast which has received the endorsement of Western fans and players. It is not used in the game, however, but in practice, or as an amusement device, and it is very popular for both purposes.

The construction is very simple, consisting of a heavy wooden backstop, eight feet by eight, which is surrounded by a netting to catch wild balls. It stands at the end of a sixty-five foot alley, the distance from which the ball is thrown on the field. The surface is painted with a dark background, on which are represented a catcher, a right-hand batter and a left-hand batter, thus affording practice for either variety. A curtain covers the one not supposed to be up.

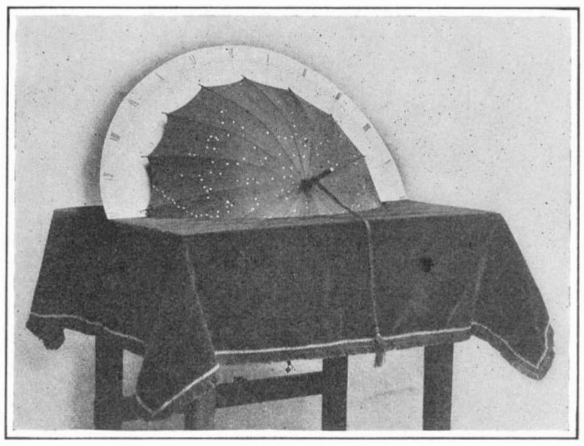
The registering device is a panel 17 inches wide and three feet four inches high, which occupies the space exactly above the plate and covers the range between the knee and shoulder of the average man. The panel is not outlined or in any other way made conspicuous, but the eye of the pitcher is supposed to pick out this invisible field just as in a real game. If he throws the ball a fraction of an inch outside this panel, there is no sound but the thud of the ball, but if he hits it, an electrical buzzer records a strike. The ball is returned automatically to the player after each throw.



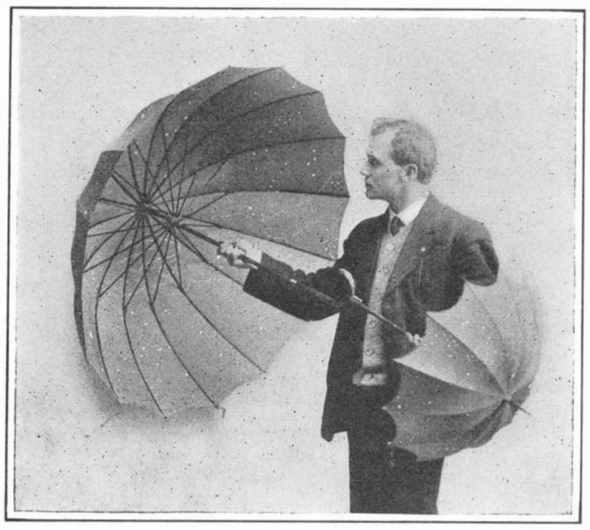
Pitcher's practising alley.

## The Heavens on a Parasol

GEOGRAPHERS have struggled long with the problem of mapping the spherical earth on a flat surface with the result that the public has acquired a most distorted impression of relative geographical positions. It is now admitted that the earth cannot be studied properly without a globe. In the same way efforts have been made to depict the heavens upon a flat map with the result that many of the constellations are so distorted as to be positively unrecognizable.



Revolving celestial globe for school use.



The northern and southern celestial hemispheres.

Sometime ago a writer in the SCIENTIFIC AMERICAN suggested that a common umbrella might serve as a celestial globe, or at least half a globe, by having the stars painted on it in their proper relative positions. This would provide a very handy star map which could be carried to the point of observation in folded position and then opened out to semi-spherical form representing the apparent form of the heavens. By pointing the umbrella stick at the North Star, the umbrella could be readily moved to a position corresponding with the heavens at the particular time, and then it would be a simple matter to pick out the various constellations.

This idea has been further improved upon by O. F. Barcus of Shanghai, China, who sends us the two photographs here reproduced. A dark blue silk parasol is used, and on it the stars are either painted or embroidered. Each parasol represents one half of the celestial sphere, and by using two a map of the entire heavens is obtained. For the purpose of teaching astronomy to school children, the parasol may be set in a table as shown in one of the photographs. The plane of the observer's horizon is represented by the table top, which has an opening cut in it, through which part of the parasol projects. The umbrella stick is pointed directly toward the North Pole of the heavens, and makes an angle with the surface of the table equal to the latitude of the place. By means of clockwork the parasol is revolved at the same speed as the apparent revolution of the heavens, and a small image of the sun placed in its proper position on the parasol (as may be found by referring to a nautical almanac) shows by its meridian the time of day on the dial at the back of the parasol. If the sun's image is placed accurately the revolving parasol will show just how far north or south of the east and west points the sun rises and sets during the year and at what time before six A. M. and after six P. M. the sun appears above the horizon.

For use in the field to identify the constellations, it is preferable to have the stars painted on the inner face of the umbrella. The parasol is provided with a narrow ribbon which may be used to determine the position of any point, the ribbon being divided into degrees by which declination may be reckoned. The ribbon is movable about the center stick of the parasol and indicates Right Ascension by hour and minute divisions marked on the rim of the parasol.

## The Distribution of Gases in the Bunsen Flame

THE Bunsen burner, in which the gas is mixed with air in order to produce complete combustion and a non-luminous flame, is no longer confined to chemical and physical laboratories, but has passed into general household use, for every incandescent gas burner is essentially a Bunsen burner. So, also, is the gas stove, which is happily and rapidly abolishing the irrational method of cooking over a coal fire. If the air inlet of a Bunsen burner is completely stopped the flame immediately becomes luminous and yellow, and blackens objects exposed to it. If the air inlet is partially stopped, this change takes place only at the tip of the flame. At the last meeting of the German Physical Society Prof. Haber discussed the question why the blackening occurs at the tip and not at the side of the flame. As the blackening is caused by incomplete combustion, which is due to insufficiency of air, the composition of the gaseous mixture must vary in different parts of the flame, so that it is less favorable to complete combustion at the tip than at the side. Chemical analysis, in fact, proves that the composition is different at the tip and at the side of the flame. Experiments with other combustible gases, hydrogen for example, show that the ascending column of the gaseous mixture separates, the heavier constituent going to the axis of the column, the lighter to the periphery. This separation is not caused by the upward flow of the gaseous mixture, for it does not occur unless the jet is lighted. It is due to the action of the flame, that is, of the combustion, which causes variations in pressure and density, in consequence of which the streamlines are curved even before they enter the conical flame. The result is an acceleration, analogous to that produced in a centrifugal separator, which explains the peculiar distribution of gas and air. In the discussion Prof. Warburg suggested that differences of temperature in different parts of the flame might play a part in the action.

## State Department Activity in Trade-mark Matters

THE U. S. Ministers to the various republics of South and Central America have received requests from the State Department to urge on the part of the countries to which they are accredited the ratification of the Buenos Ayres Trade-mark Convention of 1910. It appears that ratification by but one more of the republics of the northern group is necessary to make it effective or operative in the northern countries, and efforts to this end are being made in Costa Rica and in Salvador.

The ratification of the convention is important to American manufacturers since, as we have before pointed out, in most of the South American countries it is the one who first registers the mark who is entitled to it in such country irrespective of any use of the mark and even against one who has well established and recognized right in the market in other countries. The Buenos Ayres convention arranges for one trade-mark office at Havana, Cuba, for the northern countries, and another at Rio de Janeiro, Brazil, for the southern countries, and in the event of ratification by Salvador or Costa Rica, the office at Havana will doubtless be opened in the near future.

# Visible Speech

## The Eye Seeing and the Rule Measuring the Difference Between Sounds

By Prof. A. L. Kroeber, Department of Anthropology, University of California

On January 31st, 1914, there closed at the University of California the first exhibit of "visible speech" ever attempted on a large scale, and with a view to intelligibility by the non-technical public.

"Visible speech" is more than ordinary writing or printing. It represents the fruits of scientific endeavor to represent human language in such a way that the eye can see, and the rule measure, the difference between sounds. Mechanical processes are employed to convert the air-waves which constitute sounds into graphic tracings and diagrams that permit of classification and analysis.

The most important apparatus used for this purpose is that devised by the French Abbé Rousselot, one of the founders of the science of modern phonetics. The principle of this mechanism, like that of most useful inventions, is exceedingly simple. Essentially it is a phonograph constructed not for the purpose of producing indentations in a wax-like material which will subsequently reproduce the actual sounds uttered, but intended to record in enlarged and visible form the air movements and vibrations which are the physical basis of these same sounds. A mouthpiece and tube very much like those used in the commercial graphophone convey the sound waves to a tambour or diaphragm which is set in corresponding motion. The center of this diaphragm, which for some purposes is made of glass and for others is a membrane of soft rubber, bears a pin to which is fastened a slender straw tipped with a fine-pointed needle shaved from a piece of horn. This needle operates on a revolving cylinder of this familiar kymograph type, carrying a paper coated with that most delicate of all surfaces, soot deposited from a candle flame (Fig. 1a). When the instrument is properly attuned, even the faintest tremors of the air occasioned by scarcely audible vibrations of the vocal cords, produce motions of the needle point sufficiently large to scratch into the soot surface a fine white line whose undulations are visible to the naked eye. As soon as a tracing, or set of them, have been recorded, the paper carrying the perishable legend is passed through a bath of dilute shellac, and on drying has become permanently fixed and hardened.

### The Dying Indian Dialects.

The California exhibit is unique in representing the first and probably the most persistent endeavor to use this mechanical means of recording speech for the study and preservation of the fast-perishing native dialects of the American Indians. Very different in their sound from most European languages, these tongues are so peculiar in many respects that their examination by mechanical means has proved of the greatest value.

The University of California has been able to amass a collection of some ten thousand tracings of Indian words which will be even more highly prized in times to come when the languages to which they refer are merely a memory.

### Nose, Throat, and Mouth.

Perhaps the most valuable of all tracings are obtained by the method of simultaneous recording. Tubes leading from the Adam's apple or nose are both operated on diaphragms whose needle points have been placed parallel with the point which traces the record from the mouth. Nose records offer little difficulty, a glass bulb attached to the end of the tube being slipped into one nostril while the speaker or subject holds the other nostril shut with his finger. In all of the following illustrations which contain nose or throat records, the fact is indicated in the diagram itself.

Continental and English *r*, although written and printed with the same character of the Roman alphabet, differ very thoroughly. The acquisition of the French or German *r* is usually of considerable difficulty to the English-speaking person, whereas an absolutely correct enunciation of the English sound is almost a physical impossibility to all those attempting to acquire this speech in addition to their continental mother tongue after the age of about twenty to twenty-five. The English and German *r* sounds in Fig. 9 are particularly interesting in this connection.

The Kanaka dialect of the Marshall Islands in the South Seas shows an entirely new type of the familiar sounds *d* and *t* (Fig. 7). It has been determined that they are absolutely identical in method of formation, except that for *t* the tongue is held against the gums for a period averaging about one third of a second, whereas in *d* the same period of tongue contact lasts only about one

(Concluded on page 480.)

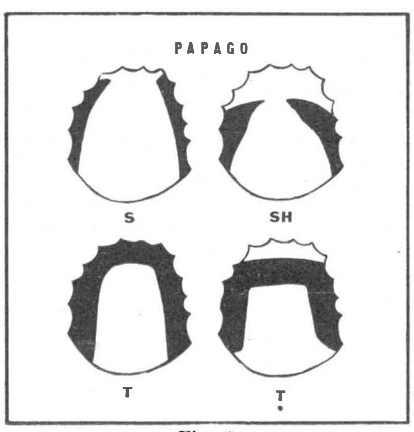
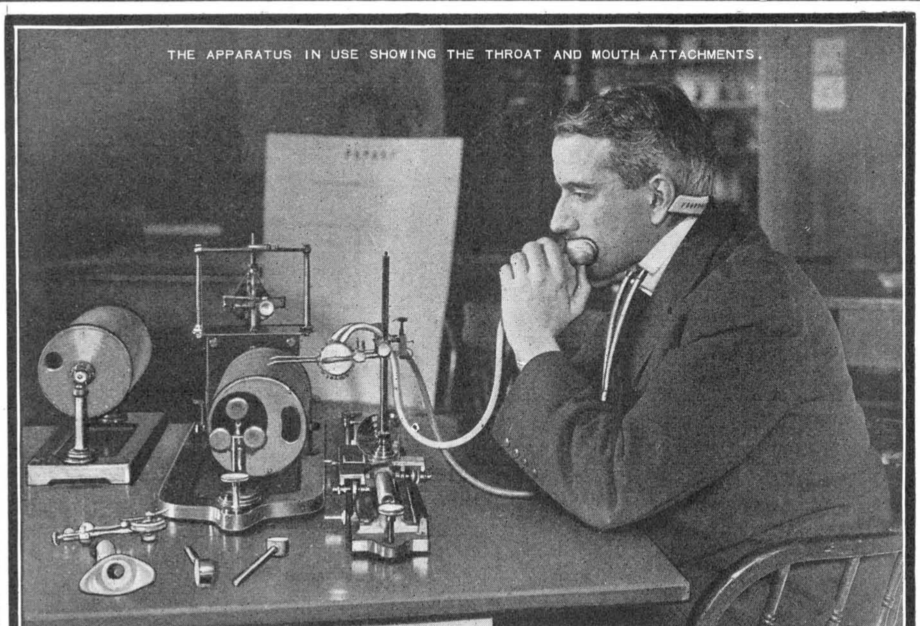



Fig. 2



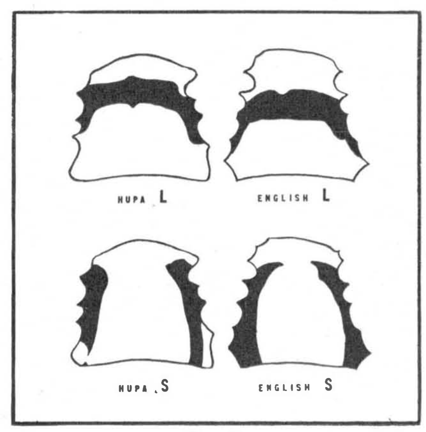




Fig. 3

Fig. 1a

Fig. 1b

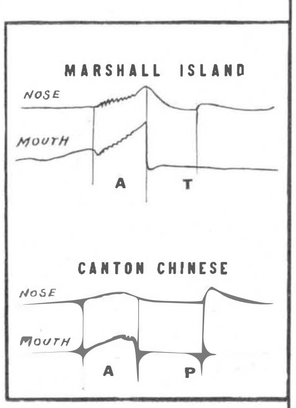
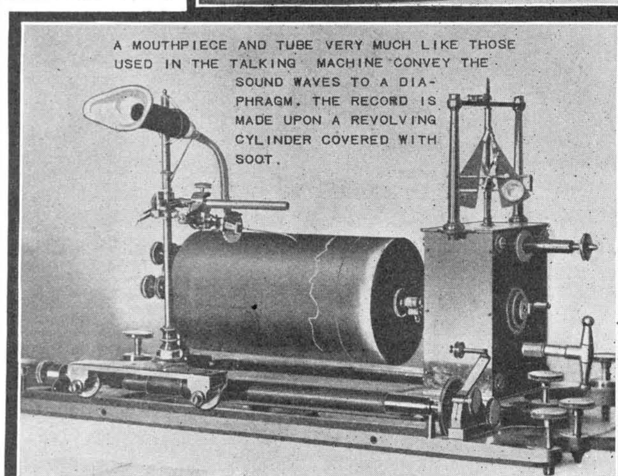
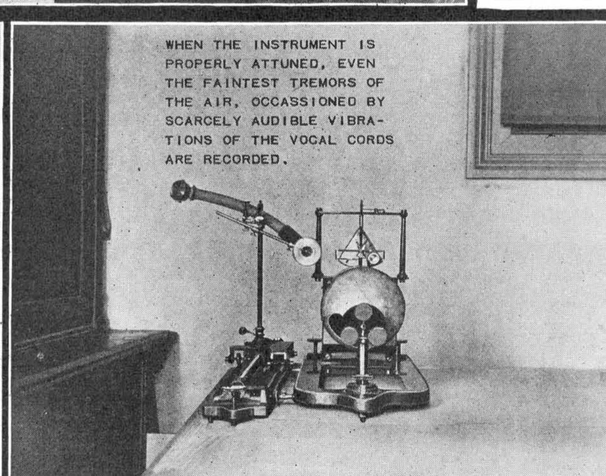



Fig. 4



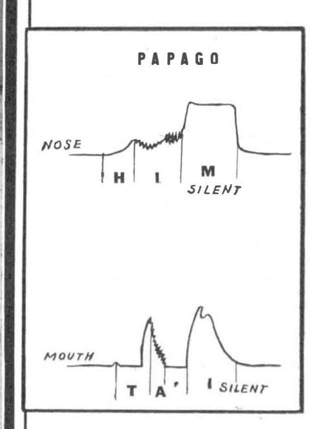
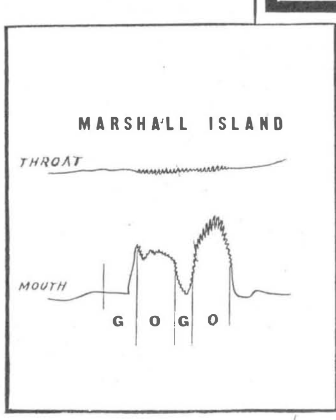
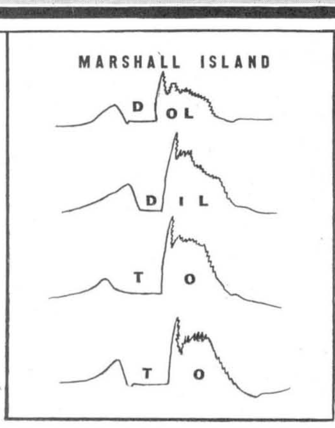
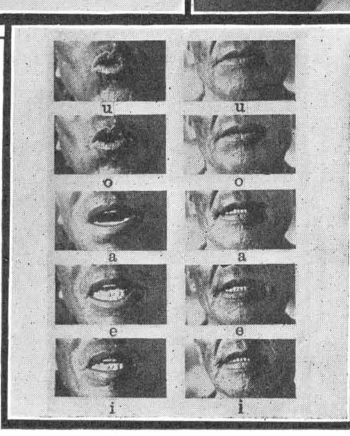
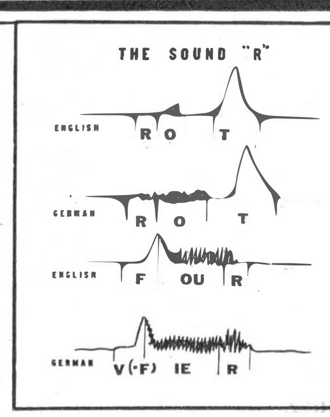




Fig. 5



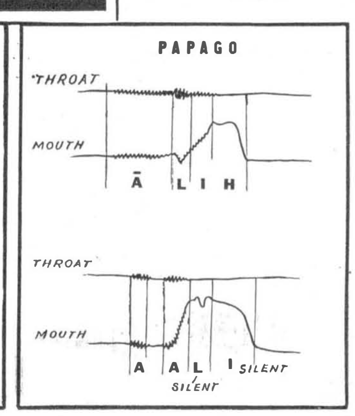




Fig. 6 Fig. 7 Fig. 8 Fig. 9 Fig. 10

Fig. 1 shows the apparatus in use. Fig. 1a is a side view of the apparatus, showing the carbon coated paper on the cylinder, and a record line scratched on it. Fig. 1b is an end view of the apparatus. Fig. 2.—"Palatograms," or false palate records. Fig. 3.—Other records secured by use of the false palate. Fig. 4.—Records of final *p*, *t* and *k* sounds. Fig. 5.—"Sniffed," or silent sounds. Fig. 6.—Records of two pronunciations of the same sound. Fig. 7.—New types of familiar *d* and *t* sounds. Fig. 8.—Lip photographs of vowels. Fig. 9.—Records of English and German *r* sounds. Fig. 10.—Influence of fully voiced vowel on succeeding sounds.

**Visible speech.**

## Actual and Theoretical Ranges of the United States Coast Defense Guns

By the courtesy of Brigadier-General William Crozier, chief of ordnance of the United States Army, the Scientific American is enabled to present a most interesting diagram, showing both the actual and theoretical ranges of the rifles and mortars with which our coast defenses are armed. The actual ranges are those which can be covered under existing conditions and with those increases in the possible elevation of the guns which are now being made. The theoretical ranges, or maximum distances to which the projectiles could be fired, are those which would be secured were the mounts so constructed that the guns could be elevated to forty-five degrees.

In the table accompanying the diagram, column 1 contains the trajectory numbers corresponding to the numbers written just below the base line of the diagram; and it should be noted that the vertical and horizontal scale are the same, so that the trajectories, as shown, are an exact reproduction to scale of the line of flight followed by the projectiles.

At the time when the 12-inch rifles and mortars were built for our fortifications, no such guns were carried on naval ships as are to be found mounted to-day. Seven to ten thousand yards was considered the maximum possible range at which warships could carry out effective artillery practice; and, consequently, it was considered that if our heavy coast defense guns were given a maximum range of thirteen thousand yards, it would enable our defenses to bring the enemy under very accurate fire long before he could get within effective bombarding range. Consequently, the maximum elevation for our rifles was set at a point (10 degrees) corresponding to 13,000 yards range for a creased the possible range. Increasing the elevation from ten to fifteen degrees makes it possible to increase the range of the 1,070 shell with an initial velocity of 2,250 foot-seconds from 13,000 yards to over 17,000 yards. Again, by using a 700-pound shell with an initial velocity of 2,700 foot-seconds and an extreme elevation of ten degrees, we get a range of about 15,500 yards, and by increasing the elevation to 15 degrees the range with the same shell and the same velocity increases to over 19,000 yards.

When the 14-inch gun was introduced the mounts were all constructed so as to permit of 15 degrees elevation, and the range of this gun when firing a 1,660-pound shell with a velocity of 2,366 foot-seconds is over 19,000 yards. If a lighter shell of 1,200 pounds weight is used, the initial velocity goes up to 2,775 foot-seconds and the range becomes over 21,000 yards.

The great 16-inch gun, with 15 degrees elevation, can throw its 2,400-pound shell to a distance of 18,500 yards, and a light 1,800-pound shell to a distance of about 21,000 yards.

By increasing the length of the 12-inch gun from 35 to 40 calibers, and increasing the powder charge the velocities, both with the 1,070- and the 700-pound projectiles, and consequently the range, have been greatly increased. Thus with ten degrees elevation, the 40-caliber, 12-inch gun throws a 1,070-pound shell to a distance of 14,500 yards and with 15 degrees elevation to a distance of 20,000 yards. The lighter 700-pound shell fired with an initial velocity of 3,100 feet per second would have a range with ten degrees elevation of 18,000 yards and with 15 degrees of 22,000 yards.

The 12-inch mortars, which are so mounted that they can be fired with elevations up to sixty degrees, can fire a 1,046-pound shell to a distance of 11,750 yards, do not remember just now what was its weight) would reach in its flight an extreme altitude of about 18 miles, and that it would not fall to earth until it had covered a horizontal distance of forty-nine miles.

Such a gun would, of course, be impracticable, for the reason that the erosion due to the enormous heat of the gases, would wear out the rifling and spoil the accuracy of the gun before very many rounds had been fired.

In this connection it is interesting to note that on April 28th, 1892, on Krupp's practice ground at Meppen, in the presence of the Emperor, a round was fired from a 24-centimeter coast gun to an angle of elevation of 44 degrees. The range was measured and found to be 22,120 yards. Furthermore, as far back as 1888, certain rounds known as the "Jubilee shots" were fired at Shoeburyness with a 9.2-inch wire-wound gun. The projectile weighed 380 pounds, the muzzle velocity was 2,360 feet per second. Three shots, fired at 40 degrees elevation, gave ranges of 20,223, 21,048, and 21,358 yards, respectively, and the observed time of flight was 63.45 seconds. Our chart shows that the Dunkirk range of 22½ miles for a 12-inch shell was perfectly possible, for we have plenty of guns, which, if mounted for that long distance, could give even greater ranges.

## The Current Supplement

The development of the aeroplane continues to be a matter of widespread importance and many will appreciate the opportunity of the article on European Aeronautical Laboratories in the current issue of the Scientific American Supplement, No. 2055, for May 22nd, 1915, to learn something of the methods followed in Europe for the scientific investigations of the many problems yet to be solved. Measuring Distances in War

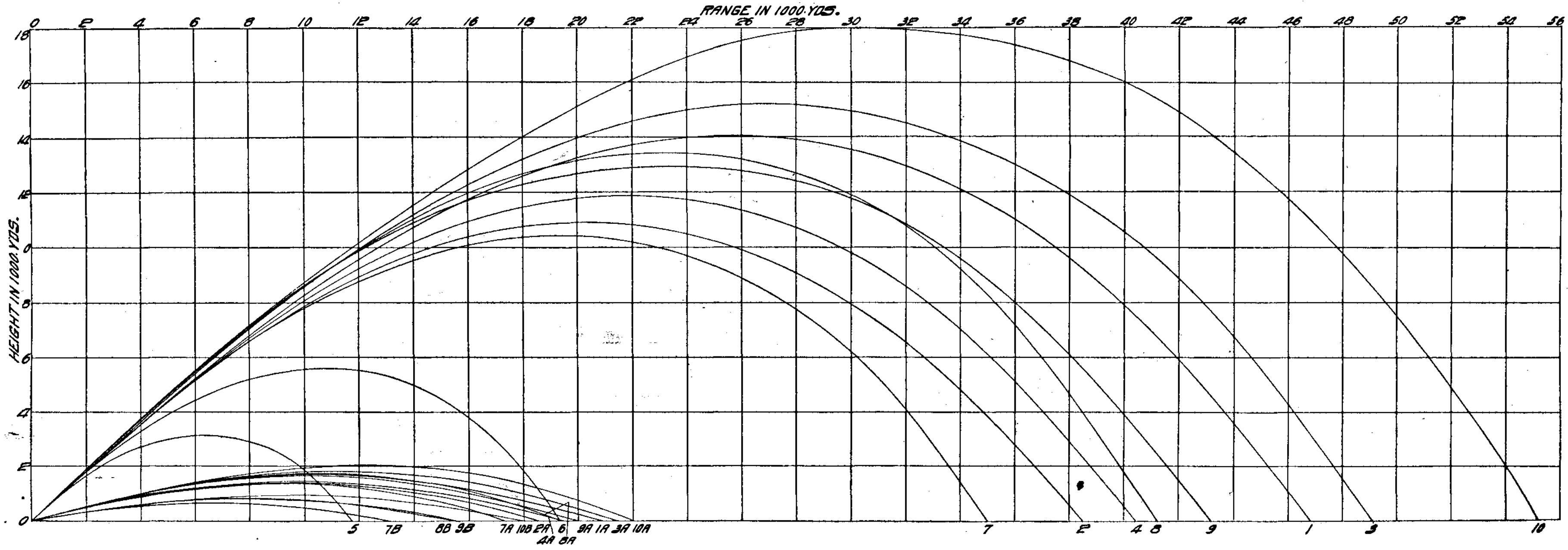



**Diagram showing the actual and theoretical ranges of the coast-defense guns of the United States.**

Note—The numbers written below the base line of diagram correspond to those given in the first column of the accompanying table under the heading "Trajectory Number."

12-inch gun, firing a 1,070-ton projectile with a muzzle velocity of 2,250 feet per second. The resulting trajectory is marked 7B on the diagram. The 12-inch, 15-caliber mortar had a maximum range when firing a 1,046-pound shell with 1,200 foot-seconds velocity, of about 11,750 yards.

With the rapid increase in the range, fire and accuracy of naval guns which has taken place in the past few years, it became necessary to increase the range of our coast defense guns. This could be done in two ways: by decreasing the weight of the shell, thereby insuring an increase in its velocity, or by maintaining the weight of the shell and increasing the elevation of the gun, or by both. A study of the diagram and its accompanying table will show to what a remarkable extent the use of these methods has in-

TABLE OF BALLISTICS OF THE U. S. COAST DEFENSE GUNS.

| Trajectory Number. | Gun Caliber. | Length Calibers. | Projectile—Weight, Pounds. | Muzzle Velocity Feet per Second. | Elevation Degrees. |
|---|---|---|---|---|---|
| 1 | 16 inch | 35 | 1,800 | 2,600 | 45 |
| 1A | 16 inch | 35 | 1,800 | 2,600 | 15 |
| 2 | 16 inch | 35 | 2,400 | 2,250 | 45 |
| 2A | 16 inch | 35 | 2,400 | 2,250 | 15 |
| 3 | 14 inch | 40 | 1,200 | 2,775 | 45 |
| 3A | 14 inch | 40 | 1,200 | 2,775 | 15 |
| 4 | 14 inch | 40 | 1,660 | 2,360 | 45 |
| 4A | 14 inch | 40 | 1,660 | 2,360 | 15 |
| 5 | 12 inch mortar | 15 | 1,046 | 1,200 | 45 |
| 6 | 12 inch mortar | 15 | 700 | 1,800 | 45 |
| 7 | 12 inch | 35 | 1,070 | 2,250 | 45 |
| 7A | 12 inch | 35 | 1,070 | 2,250 | 15 |
| 7B | 12 inch | 35 | 1,070 | 2,250 | 10 |
| 8 | 12 inch | 35 | 700 | 2,700 | 45 |
| 8A | 12 inch | 35 | 700 | 2,700 | 15 |
| 8B | 12 inch | 35 | 700 | 2,700 | 10 |
| 9 | 12 inch | 40 | 1,070 | 2,500 | 45 |
| 9A | 12 inch | 40 | 1,070 | 2,500 | 15 |
| 9B | 12 inch | 40 | 1,070 | 2,500 | 10 |
| 10 | 12 inch | 40 | 700 | 3,100 | 45 |
| 10A | 12 inch | 40 | 700 | 3,100 | 15 |
| 10B | 12 inch | 40 | 700 | 3,100 | 10 |

and by using a 700-pound shell, the range can be increased to over 19,000 yards.

If there were any occasion for using the maximum theoretical range of the 12-inch rifles, and they were mounted so that they could be elevated to 45 degrees, some very surprising results could be obtained. Thus: The 12-inch gun of 35 calibers would throw its 1,070-pound shells to an extreme range of 35,000 yards. The 16-inch guns would throw a 2,400-pound shell to a distance of 38,500 yards. The 14-inch gun would carry its 1,660-pound projectile to a distance of 40,500 yards. The 35-caliber 12-inch gun would throw its 700-pound projectile 41,000 yards, and the 40 caliber 12-inch at 45 degrees would throw its 1,070 shell 43,000 yards. The 16-inch gun, using the lighter shell, 1,800 pounds, would have a range of 46,750 yards, and the 14-inch, firing its lighter shell, 1,200 pounds, would carry to a distance of 49,000 yards.

The most spectacular result would be obtained with the 40-caliber, 12-inch gun, which, if it used a 700-pound shell, delivered with an initial velocity of 3,100 feet per second, at an elevation of 45 degrees, would throw the projectile to a vertical height of 18,000 yards, or say 10¼ miles, and it would cover a horizontal distance of 55,000 yards, or, say, 31⅓ miles.

Is this the limit? Not by any means. It would be possible to build a gun which would carry to far greater distances than these. Thus, the writer remembers several years ago reading a letter from Col. Ingalls, probably the greatest expert in ballistics in our army or in that of any army in the world, in which he gave some most astounding, but perfectly reliable figures. He had been asked to determine the trajectory of a Brown, 10-inch, wire-wound gun, with a very large powder chamber and the enormous muzzle velocity of 4,000 feet per second. He found that the projectile (we

describes the ingenious instruments, generally known as "range finders," by means of which the distance of an enemy's position can be accurately ascertained, and explains the principles involved. There is also a description of the periscope that gives considerable information in regard to different types, and diagrams showing their construction. Another interesting article, that is also fully illustrated, is that describing a very ingenious tele-photographic apparatus by which transmitted letters or characters are directly visible to the eye. The Romance of the Motion Picture gives some interesting facts about the early history and the development of this popular form of amusement. There is an interesting description of how the big guns used in our dreadnoughts and coast defense forts are made; guns that will throw a projectile twenty to thirty miles, and which are claimed to be the best in the world. A communication from a correspondent furnishes a description of America's first submarine, and a graphic account of an attempt to operate it in New York harbor. There is another of the invaluable lectures on Atoms and Ions, by Sir J. J. Thomson; and the article on the Pathology of mental disorders is concluded. There is also the usual number of shorter but valuable notes on various topics.

**An Interesting Panoramic Camera.**—Joseph Becker of Washington, D. C., has patented, No. 1,136,761, a novel panoramic photographic camera for taking true perspectives just as the object would appear to the eye of an observer, by means of a lens which, as it swings, changes its focal length. The camera as constructed has a compound objective which revolves about a vertical axis and has means for changing the radial distances of one or more of its component lenses from the axis of rotation during the rotation.

# Correspondence

[*The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.*]

## Naval Lessons of the War

To the Editor of the SCIENTIFIC AMERICAN:

It perhaps seems a little premature at the present time to formulate any positive conclusions that may be drawn from the naval operations of the European war or to apply them in the naval construction of the near future, but there is one vital truth, it seems to me, which has at last become unmistakable in its convincing evidence of actual battle record after several years of theoretical and academic deductions.

It is the old question of the future battleship, always a compromise, with the extremes of the very fast all-big gun but lightly armored battle-cruiser and the much slower but heavier armed and armored dreadnought. The merits pro and con of these two classes of capital ships, their examples in the different navies of the world, and lately the gradual merging of the two types have been written of in your columns many times, so I will not repeat them here, but simply bring out what I believe is most important, i. e., the immediate realization on the part of the United States naval designers of the inferiority of even the latest of our big-gun vessels and publicity on this question through such papers as the SCIENTIFIC AMERICAN.

Our designers have always gone on the theory that, in considering all the points of armament, armor speed, and radius of action, speed was the least important factor, and that as some one feature must be sacrificed to attain the best result for the purpose of our navy, speed should be considered last of all. Thus, all of our dreadnoughts, from the "Michigans" right down through the two "Pennsylvanias" launching this year and the three "Californias" authorized last year, have the heaviest armament possible for their displacement and maximum broadside fire, and the heaviest armor of any ships of the same class and date in the world, but speeds of only from 18 to 22 knots. To be sure, we need battle-cruisers, but not being able to get them without sacrificing our battleship appropriations, we should have compromised even further on the mere theory of the thing. Now, the war has driven it home to us and not too late to take effect on the design of the two new vessels authorized this year if action is taken at once, which ships, if we refuse to change our ideas, will probably be merely slightly improved "Californias."

To-day the 14-inch and 15-inch guns are the accepted naval armament standards; the 16-inch gun is being experimented with and will arrive shortly. The sea engagements of the present war have shown that no armor can withstand the modern armor-piercing shell of large size even at extreme ranges, that the new high explosive shells are more destructive than we ever expected, and that it is no longer a question of being able to keep afloat by taking a lot of hammering and pounding back in return, but simply of landing a few salvos on the enemy *first* and sinking him, or you get sunk yourself. This simply means big caliber guns, lots of them, and ability to open fire at the range of *your choosing*, not the enemy's; in other words, superior or at least equal speed. The ordnance makers have at last far outstripped the armor manufacturers and armor becomes a minor factor. In the fight off Coronel and the Falkland Islands the comparatively heavy armor for the caliber of guns it was opposed to was useless. The defeated squadron in each case might better have had quicker heels, and while both engagements were decided by the overwhelming gun-fire of the victors and superior speed, the results would have been the same, though longer perhaps in attainment, if the opposing armaments had been equal. The faster fleet in that case would have simply stood off and pounded away at a favorable range for its own calibers, in a favorable position as to wind and sun (a very important factor in the Coronel fight), and a line of bearing most favorable to itself which would return greater damage per shot and greater concentration of fire. (This last was an important feature of the Falkland Islands battle.) All this is, of course, assuming equal fire accuracy, an equal number of units, and an equal number of guns of equal calibers. But when the fleets are unequal, as in the North Sea fight, the speed factor multiplies in importance. There we see an engagement of battle-cruisers, with the possible exception of the "Bluecher," five against four, fire commencing at 17,000 yards. The "Bluecher" was doomed from the start because of her slow speed of 26 knots (faster than any fighting ships in our navy). The heaviest armor in the world and even more and heavier guns could not have saved her. Speed alone could and did save her sisters while she received the concentrated broadsides of each pursuing ship as she passed. And, on the other side, *speed* was the factor that enabled the victorious squadron to severely punish the German battle-cruisers and without which the British could not have claimed a victory in a running fight. They would simply have recorded the sinking of one ship of the enemy. As it was, the mine-fields alone prevented a more decisive result.

So, the importance of armor being nullified, whether it be in actions between armored cruisers, battle-cruisers, battleships, or dreadnoughts, it is evident that a vessel of 30,000 or 33,000 tons displacement mounting twelve or more 14-inch or 15-inch guns on a speed of from 28 to 30 knots or over with as much thickness of armor as can be secured in conjunction with the other two factors, is the ideal type of capital ship. Germany realizes it by now; England will produce it immediately following her "Malayas" and "Royal Sovereigns" and "Queen Mary"; while Russia, generally the most backward of all the powers in naval development, has struck it right at last and is already commissioning her four "Kinburns" of 32,200 tons displacement, 27 knots speed, and mounting twelve 14-inch and twenty-one 5.1-inch guns. Of course, like all Black Sea built ships, they probably have small fuel capacity and therefore small radius of action, which accounts for the heavy armament; but the ideal is there and can be developed further.

The situation of the United States is serious. Not only could the "slow" and 25- and 26-knot dreadnoughts steam rings around our main fleet, but we haven't even any fast cruisers to pick off isolated units of the enemy or harass him, or even any scouts to locate him in time to insure an advantageous disposition of our forces. And the inevitable result, as foretold in the Pacific, South Atlantic, and North Sea, in spite of equality in numbers and marksmanship and seamanship and the greatest bravery of our *personnel*, gives large quantities of nourishing food for the minds of our naval experts at the present moment. Let us throw our ultra-conservatism overboard and save this year's ships before it is too late.

HAROLD M. KENNARD.

Brooklyn, N. Y.

## The Naval Review at New York

ALTHOUGH the noble array of warships which was gathered last week in the North River does not by any means represent the full strength of our Navy, it was a striking expression of its high quality, particularly as regards the first fighting line as represented by the dreadnoughts. The impression produced upon the minds of the citizens who saw the review was determined by the point of view from which they looked at it. Judged as an assemblage of modern fighting ships, irrespective of any considerations of its strength relatively to the naval strength of the other nations of the world, it was calculated to arouse a very proper patriotic pride; for the dreadnoughts, pre-dreadnoughts, destroyers, submarines, and particularly the auxiliaries were among the very best in their respective classes that are to be found in the world to-day. The dreadnoughts, particularly in regard to the center-line distribution of their guns (a distinctively American arrangement) have received the unqualified commendation of the naval designers of every navy in the world. Their batteries are excellently placed and the armor and interior bulkhead protection is as good as the best and considerably better than that on most of the ships of the foreign navies.

It may surprise some of our readers to know that relatively to the other navies the most advanced and best elements in the whole fleet were the auxiliaries, and particularly the large colliers; for we have paid particular attention to the question of ability to keep the seas, and to this end, instead of following the foreign practice of utilizing existing merchant ships as colliers, we have built a class of large and exceedingly well-equipped vessels of great carrying capacity and good speed, which in the event of war will prove to be of incalculable advantage to the American fleet. Our destroyers are the largest and most powerfully armed afloat. Our modern submarines are thoroughly up-to-date, so far as the later units are concerned, and, after a little more shaking down, the modern boats in this class will be as good as any in the world, with the possible exception of those of the German navy, which owe such superiority as they have to German proficiency in the construction and operation of oil motors.

The most serious defect in the fleet is the absence of modern scouts and of any representative of that most useful and formidable type, the battle-cruiser. If Congress in the future, as it ought to, should adopt the budget system, voting the total sum required and leaving to its naval experts the question of its distribution among the various types of vessels, one of the first things to be done will be to include some battle-cruisers in our next naval programme and also to make provisions for at least half a dozen scouts of the latest and fastest type.

So far so good. If the fleet is to be considered by itself and without reference to any other standard of strength, on the whole it is calculated to create a sense of pride and security. But the proper point of view, if one would gain a true sense of the adequacy of our fleet to the national needs, is to judge it in comparison with the fleets of other nations, and particularly of those which are now engaged in the great European conflict. If this be done, we shall have the alarming fact brought home to our minds that, in point of strength, our Navy is to be considered as in the third class and utterly unable to engage with any hope of success the fleets of the two principal naval powers engaged in the present war, namely, those of Great Britain and Germany.

If anyone doubt this, let him look at the facts. Thanks to the great naval activity in the shipyards of contending nations, Great Britain to-day has completed a total of thirty-eight dreadnoughts. Germany has twenty completed. The United States has eight only, or, if we stretch the point to include the comparatively small and slow "Michigan" and "South Carolina," we have ten.

It is our patriotic duty to draw attention to these facts, and particularly at such time of jubilation as that expressed by a great national naval review. In view of the large size, the enormous wealth and the ambitious foreign policy of the United States, it is certain that her Navy should be at least the equal of that of Germany. Instead of eight or ten ships of the first line, we should have at least twenty. After the Spanish war, under the influence of the lessons as to the value of sea power taught by that conflict, we built up our Navy so rapidly that by the year 1904 we were easily the second naval power—as we should be. Our present condition of relative weakness is due to the fact that since 1904, Congress has allowed political considerations to interfere with the upbuilding of the Navy, and we have steadily dropped back to our position of a poor third.

The most modern dreadnoughts of the fleet were the "New York" and "Texas," 27,000-ton ships, each mounting ten of the new 14-inch guns and twenty-one 5-inch —the former a fine piece which will form the main armament of the new "Oklahoma" and "Nevada" and of the "Pennsylvania" and "Arizona" and of all future ships, unless, indeed, it should be decided to mount the 16-inch gun. The "Wyoming," the flagship of Admiral Fletcher, of 26,000 tons, completed in 1912, carries, like her sister the "Arkansas," twelve 50-caliber 12-inch guns in six two-gun turrets and twenty-one 5-inch. These are, to our thinking, the most shapely dreadnoughts afloat, the long straight sheer of the main deck giving them an appearance of length greater than they actually possess. The "Utah" and "Florida," of 21,825 tons, mounting ten 12-inch 45-caliber guns and sixteen 5-inch, were completed in August, 1911. The "Delaware" and "North Dakota," our first dreadnoughts, were completed in 1910. These are vessels of 20,000 tons, carrying ten 45-caliber 12-inch and fourteen 5-inch. The dreadnought line also included the two semi-dreadnoughts, the "Michigan" and "South Carolina," vessels of 16,000 tons, carrying each eight 45-caliber 12-inch and twenty-two 3-inch guns. These two ships were originally intended to be of the "Vermont" class, but after the designs were produced, and due to the appearance of the British dreadnought, it was decided to give them a main battery entirely of 12-inch guns.

Of the same displacement as the "Michigan" was the "Kansas," carrying four 45-caliber 12-inch, eight 8-inch, twelve 7-inch, and twenty 3-inch guns. She was the last of our pre-dreadnought class to be built. Her sister ships at the review were the "New Hampsire" and the "Louisiana," whose displacement, speed and armament, etc., are practically the same as those of the "Kansas." These ships were built in 1906 and 1907.

The two-deck turret type was represented by the "Georgia," "Nebraska," and "Virginia," and "Rhode Island." The armament of these ships consists of four 40-caliber 12-inch, eight 8-inch, and twelve 6-inch guns.

The destroyer fleet consisted of fourteen vessels with their flagship, the scout cruiser "Birmingham" and the tender "Dixie."

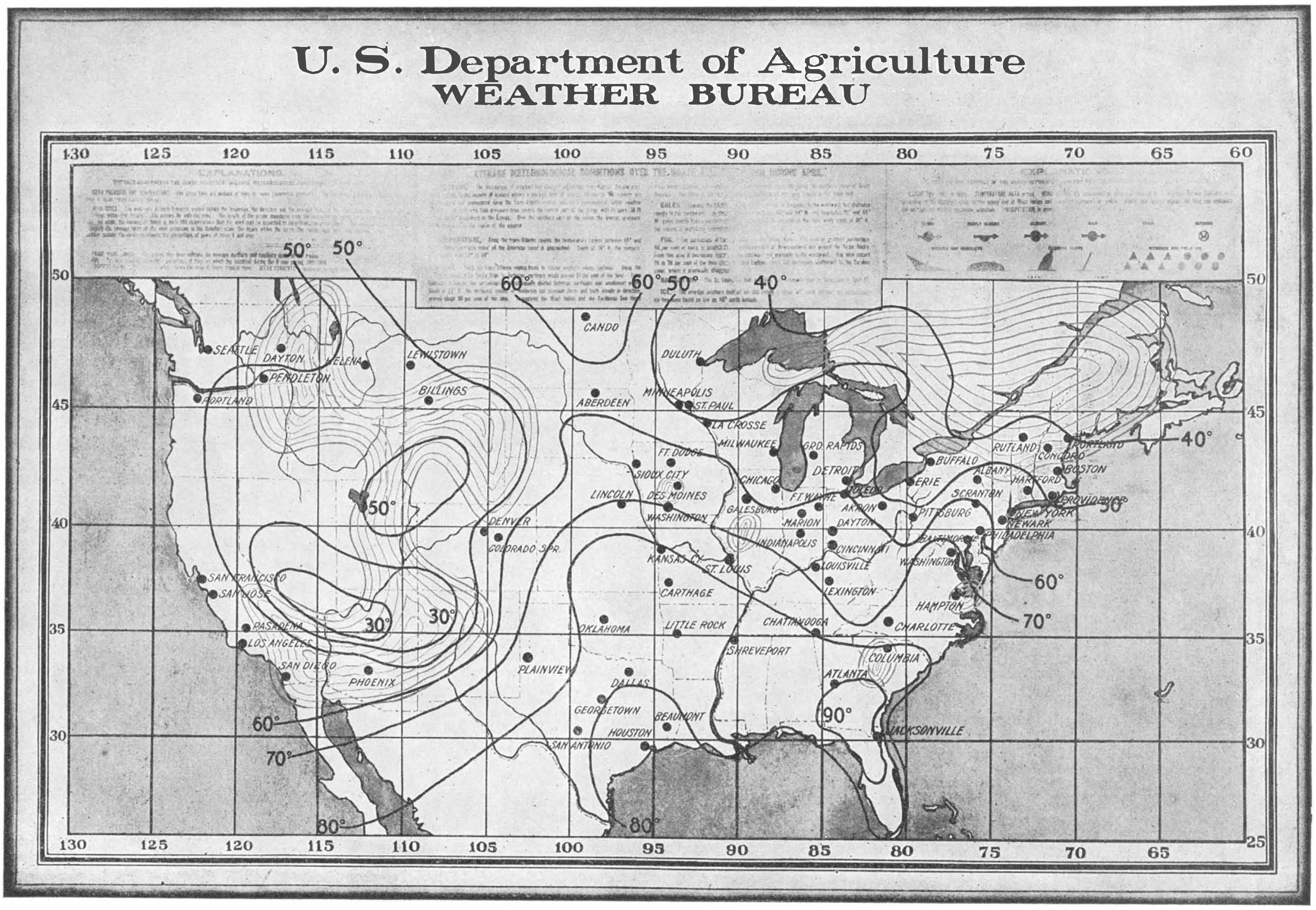
Between 138th and 142nd streets were a dozen of our latest submarines of the "D," "E," "G," and "K" classes, with several tenders.

Off Fort Washington Park was moored a fine fleet of auxiliaries, among which were the mine-laying cruiser the "San Francisco," the supply ship "Celtic," and the fuel ships "Neptune," "Orion," "Cyclops" and "Jupiter." Present also was the repair ship "Vestal" and the hospital ship "Solace."

## 4,250-Pound Block of Coal for Fair

A SINGLE block of coal, six and a half feet long, five feet wide and about three feet thick, has arrived from Higbee, Mo., *en route* to San Francisco, where it will be placed on exhibition in the Missouri mining display.

The specimen was received by Otto Rhul, who is preparing an exhibit. It weighs 4,250 pounds, and is securely crated in a framework made of timbers.




SATURDAY, May 1st, 1915, at five o'clock in the afternoon, the U. S. Government Weather Bureau at Washington marked this map showing weather conditions during the Great National Efficiency Test of the Franklin Car that day.

Throughout the Rocky Mountain States there was rain. In thirty localities high winds prevailed. At Chicago, Buffalo, Cleveland, Detroit and other lake points there was a fifty-mile gale to contend with.

This automobile test was for the American public the most significant ever held.

Its effects will be felt by every American able to own and run a motor car—and there is an automobile to every seventh voter in the United States.

### *The Cost of Inefficiency*

The nation's yearly tire bill is more than $200,000,000—its gasoline bill more than $150,000,000. Add the sums spent for repairs—for unnecessary wear and tear, and you have an annual expenditure startling even to a people like ourselves, accustomed as we are to big figures.

The waste due to inefficiency is a drain on the economic life of the country.

The subject of *Motor Car Efficiency* enlisted the special interest of the great American Universities and Technical Institutes.

Laboratory tests at Yale and at the Worcester Polytechnic Institute, showing the remarkable efficiency of the Franklin in comparison with other cars, excited professional comment everywhere.

Other Universities took up the study of the Franklin principles.

The Engineering Department of the State University of Kentucky made "The Test of the Franklin Car" a thesis required for graduation.

This is an age of efficiency. Men's minds have a practical turn. So widespread became the interest, that to supplement laboratory tests a Great National Efficiency Test on the road was arranged.

### *The Great National Efficiency Test*

Among the Supervisors of the test were representatives from the Engineering Departments of the following Universities: Toronto, Yale, Pittsburgh, Cornell, Pennsylvania, Brown, Rochester, Syracuse, Kentucky, Ohio, Lehigh, Cincinnati, Nebraska, Washington, Rensselaer Polytechnic Institute, Armour Institute of Technology, Stevens Institute of Technology, Massachusetts Institute of Technology and Pratt Institute.

At nine o'clock on the morning of May first, the Franklin Cars started in all parts of the United States and Canada, over all sorts of roads, and regardless of weather conditions.

Each car carried a Supervisor of Tests, who had already certified the preliminary details—

The gasoline tested to prove that it was the ordinary commercial quality; officially measured by the Sealers of Weights and Measures of the respective states—

The routes planned so the cars would be compelled to go and return by the same roads to equalize any advantage of wind and grade—

The car a regular model Franklin Car—

The drivers men with experience on a par with the average automobile owner.

Results: 137 regular Franklin Cars, in 137 Cities, averaged 32.1 miles to a single gallon of gasoline—

The highest record 55 miles to a gallon of gasoline—

44 cars averaged 40 miles to a gallon of gasoline.

## *A New Standard for Measuring Motor Car Efficiency is Established*

Here at last, with this remarkable record, the Franklin Car establishes a standard for comparison of automobile *efficiency*. It provides the public with a simple and definite means for judging automobile *values*—the best they have had since the automobile was invented.

Everybody knows how to judge the relative value of upholstery, paint, leather, fittings—the things on the outside of a car.

It is the things on the *inside*—things the buyer doesn't see, that burn up money.

If a car is not right in design, in construction, in material, it will show first in the *gasoline tank*.

Engineers determine the efficiency of an automobile by comparing the *useful power* delivered to the *driving wheels*, with that which is lost by friction.

Gasoline Consumption will show up inefficient tires. They will use extra power in friction—*more gasoline is used*.

Gasoline Consumption will show up excessive weight. Excess weight requires more power to move—*more gasoline is used*.

Gasoline Consumption will indicate whether a car will last. Where more gasoline is used there is *friction*, and where there is friction there is wear and tear.

Gasoline Consumption will show up useless mechanical complications. The more working parts to a car the greater the friction—*more gasoline is used*.

The mileage secured from a gallon of gasoline is a true indication of the total efficiency of the whole car. It takes into account the efficiency of the tires, axles, universal joints, transmission, clutch, mechanical efficieney of the engine, thermodynamic efficiency of the engine—everything about the car.

Consider what this test of the Franklin Car means to you—to every owner of an automobile—to the scientific and technical men who watched the test from start to finish.

Think what it means when so little power is lost by friction: when the maximum of power is delivered to the driving wheels with an average of 32.1 miles to a gallon of gasoline the country over!

Only a Fine Car can do it.

You have had your experience. Now make your comparisons.

## *Sworn Final Results*

| City | Driver | Road | Record |
|---|---|---|---|
| Akron, O. | A. Auble, Jr. | Good | 51.8 |
| Aberdeen, S. D. | G.M.Worthington | Rough | 22.7 |
| Albany, N. Y. | C. G. Heck | Heavy | 30.5 |
| Amboy, Ill. | A. Aschenbrenner | Good | 25.6 |
| Athens, O. | C. H. Welch | Dry | 31.8 |
| Atlanta, Ga. | W. M. Hull | Rough | 31.3 |
| Auburn, N. Y. | G. H. Leonard | Muddy | 31.4 |
| Baltimore, Md. | W. F. Kneip | Good | 38.0 |
| Bar Harbor, Me. | F. L. Savage | Muddy | 22.2 |
| Billings, Mont. | Arthur Barth | Muddy | 20.0 |
| Binghamton, N. Y. | S. H. Lewis | Muddy | 27.0 |
| Boston, Mass. | Otto Lawton | Fair | 39.9 |
| Brooklyn, N. Y. | G. B. Perkins | Fair | 36.1 |
| Buffalo, N. Y. | George Ostendorf | Fair | 26.2 |
| Canton, O. | G. W. Belden | Good | 43.5 |
| Carthage, Mo. | A. L. Caulkins | Muddy | 36.0 |
| Charlotte, N. C. | J. D. Woodside | Fair | 36.2 |
| Chattanooga, Tenn. | J. H. Alday | Dry | 30.3 |
| Chicago, Ill. | F. H. Sanders | Good | 30.7 |
| Cincinnati, O. | Newman Samuel | Dry | 35.7 |
| Cleveland, O. | R. H. Eckenroth | Fair | 24.4 |
| Colorado Springs, Col. | G. W. Blake | Fair | 30.7 |
| Columbia, S. C. | Wm. Gibbes | Good | 26.1 |
| Columbus, O. | O. C. Belt | Dry | 31.7 |
| Concord, N. H. | W. E. Darrah | Wet | 33.6 |
| Cortland, N. Y. | J. A. Farrell | Wet | 28.8 |
| Dallas, Texas | W. G. Langley | Good | 38.6 |
| Danvers, Ill. | Frank Simpson | Fair | 31.5 |
| Dayton, O. | F. B. Heathman | Good | 30.5 |
| Decatur, Ill. | C. E. Dawson | Dry | 32.9 |
| Denver, Colo. | F. C. Cullen | Heavy | 21.0 |
| Des Moines, Iowa | S. P. Johnston | Good | 34.2 |
| Detroit, Mich. | W. J. Doughty | Fair | 42.3 |
| Duluth, Minn. | J. T. Peacha, Jr. | Heavy | 35.2 |
| Eau Claire, Wis. | G. R. Wood | Fair | 26.7 |
| Elizabeth, N. J. | F. V. Price, Jr. | Poor | 40.8 |
| Elmira, N. Y. | Fred M. Jones | Muddy | 31.4 |
| Erie, Pa. | John Griffith | Fair | 31.5 |
| Fall River, Mass. | Ernest Place | Fair | 37.8 |
| Falmouth, Mass. | F. W. Crocker | Heavy | 28.9 |
| Fleetwood, Pa. | Wilson Sell | Fair | 34.1 |
| Fort Wayne, Ind. | L. Ohnhaus | Good | 31.9 |
| Galesburg, Ill. | E. T. Byram | Dry | 22.6 |
| Geneva, N. Y. | W. W. McCarroll |  | 34.5 |
| Georgetown, Texas | T. J. Caswell | Dry | 23.6 |
| Grand Forks, N. D. | J. W. Lyons | Heavy | 24.3 |
| Grand Rapids, Mich. | J. R. Jackson | Fair | 28.1 |
| Great Falls, Mont. | B. D. Whitten | Dry | 37.6 |
| Greensburg, Pa. | E. L. Turner | Dry | 28.6 |
| Greenville, S. C. | R. N. Tannahill | Dry | 34.4 |
| Hampton, Va. | J. V. Bickford | Fair | 22.0 |
| Hartford, Conn. | H. P. Seymour | Good | 40.4 |
| Helena, Mont. | W. L. Swendeman | Muddy | 18.4 |
| Holtville, Cal. | W. J. Seat | Sandy | 24.1 |
| Hoosick, N. Y. | John Moseley | Fair | 36.4 |
| Houston, Texas | Rudolph B. White | Rough | 22.5 |
| Indianapolis, Ind. | Glenn Diddel | Good | 35.0 |
| Ishpeming, Mich. | E. R. Nelson | Heavy | 27.9 |
| Ithaca, N. Y. | H. L. Cobb | Fair | 30.4 |
| Jacksonville, Fla. | W. F. Winchester | Dry | 30.0 |
| Kankakee, Ill. | F. A. Babel | Good | 29.1 |
| Kansas City, Mo. | E. F. Williams | Fair | 43.7 |
| Kingston, N. Y. | W. M. Davis |  | 32.3 |
| LaCrosse, Wis. | Alfred James | Dry | 29.0 |
| Lake Park, Iowa | H. C. Meyer | Rough | 27.6 |
| Lexington, Ky. | V. K. Dodge | Dry | 33.5 |
| Lincoln, Neb. | Fred M. Ryan | Rough | 24.6 |
| Little Rock, Ark. | J. F. Jones | Dry | 37.1 |
| Los Angeles, Cal. | R. C. Hamlin | Good | 35.1 |
| Louisville, Ky. | G. M. Younger | Dry | 36.8 |
| Marion, Ind. | M. L. Swayzey | Good | 33.0 |
| Meriden, Conn. | J. F. Miller | Dry | 49.2 |
| Milwaukee, Wis. | Wm. F. Sanger | Fair | 51.2 |
| Minneapolis, Minn. | L. A. McKay | Good | 47.8 |
| Moline, Ill. | D. H. Duncan | Fair | 23.1 |
| Montreal, Can. | H. Grothe | Muddy | 24.6 |
| Neenah, Wis. | J. F. Stroebel | Dry | 26.3 |
| New Bedford, Mass. | S. C. Lowe | Good | 33.0 |
| Newark, N. J. | W. L. Mallon | Dry | 36.5 |
| New Haven, Conn. | Cowles Tolman | Dry | 55.0 |
| New York City | Glenn A. Tisdale | Wet | 35.2 |
| Oil City, Pa. | H. S. Phinny | Sandy | 18.3 |
| Oklahoma City, Okla. | J. W. Lee | Good | 36.3 |
| Paris, Ky. | C. A. Weber | Fair | 34.0 |
| Pasadena, Cal. | W. P. White | Good | 31.4 |
| Paterson, N. J. | Nicholas Hughes | Good | 34.9 |
| Peoria, Ill. | S. K. Hatfield | Good | 34.3 |
| Philadelphia, Pa. | James Sweeten, Jr. | Wet | 41.9 |
| Phoenix, Ariz. | George Hageman | Wet | 53.0 |
| Pittsburg, Pa. | W. Murray Carr | Dry | 34.2 |
| Plainview, Texas | John J. Ellerd | Muddy | 21.1 |
| Portland, Me. | H. D. Cushman | Muddy | 24.9 |
| Portland, Ore. | J. C. Braly | Good | 43.8 |
| Providence, R. I. | W. L. Wilcox | Wet | 43.8 |
| Putnam, Conn. | O. C. Bosworth | Muddy | 29.8 |
| Redlands, Cal. | B. S. Hatfield | Muddy | 26.0 |
| Regina, Sask., Can. | A. O. Store | Good | 33.9 |
| Remington, Ind. | C. B. Johnston | Dry | 25.5 |
| Rochester, N. Y. | G. R. MacCollum | Good | 34.5 |
| Rockford, Ill. | L. J. Theiss | Fair | 33.4 |
| Rutland, Vt. | O. H. Coolidge | Muddy | 26.6 |
| Saginaw, Mich. | Fred H. Witters | Dry | 25.1 |
| San Antonio, Texas | L. F. Birdsong | Dry | 35.6 |
| San Diego, Cal. | W. S. Smith | Muddy | 29.8 |
| San Francisco, Cal. | John F. McLain | Good | 36.1 |
| San Jose, Cal. | L. Normandin | Good | 35.6 |
| Saranac Lake, N. Y. | E. E. Bellows | Wet | 30.3 |
| Scranton, Pa. | O. D. DeWitt | Rough | 36.4 |
| Seattle, Wash. | W. A. Wicks | Good | 39.3 |
| Sharon, Pa. | C. H. Wiltsie | Dry | 24.4 |
| Shreveport, La. | J. M. Nabors, Jr. | Dry | 22.2 |
| Sioux City, Iowa | Thomas Murphy | Soft | 23.5 |
| Sioux Falls, S. D. | Knapp Brown | Good | 41.0 |
| South Bethlehem, Pa. | L. L. Sterner | Fair | 25.8 |
| Springfield, Mass. | F. G. Jager | Heavy | 36.1 |
| Springfield, Mo. | H. E. Seeley | Fair | 26.9 |
| St. Louis, Mo. | J. B. Dryer | Wet | 36.9 |
| St. Paul, Minn. | A. H. Clark | Fair | 31.8 |
| Syracuse, N. Y. | C. W. Bull | Fair | 41.7 |
| Toledo, Iowa | Harvey Jones | Heavy | 24.8 |
| Toledo, O. | C. B. Sage | Good | 31.7 |
| Toronto, Ont., Can. | A. W. Wilson | Good | 34.9 |
| Trenton, N. J. | Walter Richards | Bad | 25.8 |
| Utica, N. Y. | W. W. Garabrant | Heavy | 39.3 |
| Vincennes, Ind. | D. D. Aldrich | Poor | 35.7 |
| Walla Walla, Wash. | R. H. Tuttle | Muddy | 34.2 |
| Walton, N. Y. | J. R. Bryce | Muddy | 18.8 |
| Washington, D. C. | D. S. Hendrick | Good | 33.8 |
| Waterloo, Iowa | R. H. Cramer | Fair | 39.7 |
| Wellsville, N. Y. | Oak Duke | Fair | 27.7 |
| West Brooklyn, Ill. | J. W. Thier | Rough | 35.1 |
| Wheeling, W. Va. | J. J. O'Keefe | Good | 26.2 |
| Williamsport, Pa. | S. A. Courson | Bad | 20.3 |
| Wilkes-Barre, Pa. | W. S. Lee | Sticky | 34.1 |
| Wilmington, Del. | Peter Hanson | Fair | 23.1 |
| Worcester, Mass. | F. B. Williams | Muddy | 29.7 |
| Youngstown, O. | Jacob Stuhldreher | Good | 27.9 |

## *Make Your Own Comparisons*

Many people do not want agents calling on them until after they look into and check up the facts—then make their own comparisons.

To any man or woman who cares enough about motor car efficiency—motor car economy—to write us, asking for *Franklin Facts*, asking us to show why the Franklin Car is the most efficient automobile in America today—why it is the easiest riding car—why it will go further in a day, with the greatest comfort and least expense—we will send the proofs.

We rely entirely upon our certified facts, upon proven results. They mean so much to you, we want you to have them even though you do not buy another car in five years.

FRANKLIN AUTOMOBILE COMPANY
Syracuse, New York

# Connecting Idaho With the Sea

## Completion of the Celilo Canal Along the Columbia River

By Fred W. Vincent

THE largest lock canal in the West has just been completed by the Federal Government on the Oregon side of the Columbia River just above the Dalles, Oregon. This waterway makes the Columbia River navigable continuously for 500 miles from the sea. It is eight and one half miles in length, and was constructed at a total cost of approximately $5,000,000. The construction period ranged over almost a decade, and the operations have progressed with practically no interruption since the initiation of the huge job in 1906. The canal was formally opened to traffic on May 5th, with elaborate ceremonies in which all parts of the 300,000 square miles of territory comprising the Columbia basin were represented by prominent citizens.

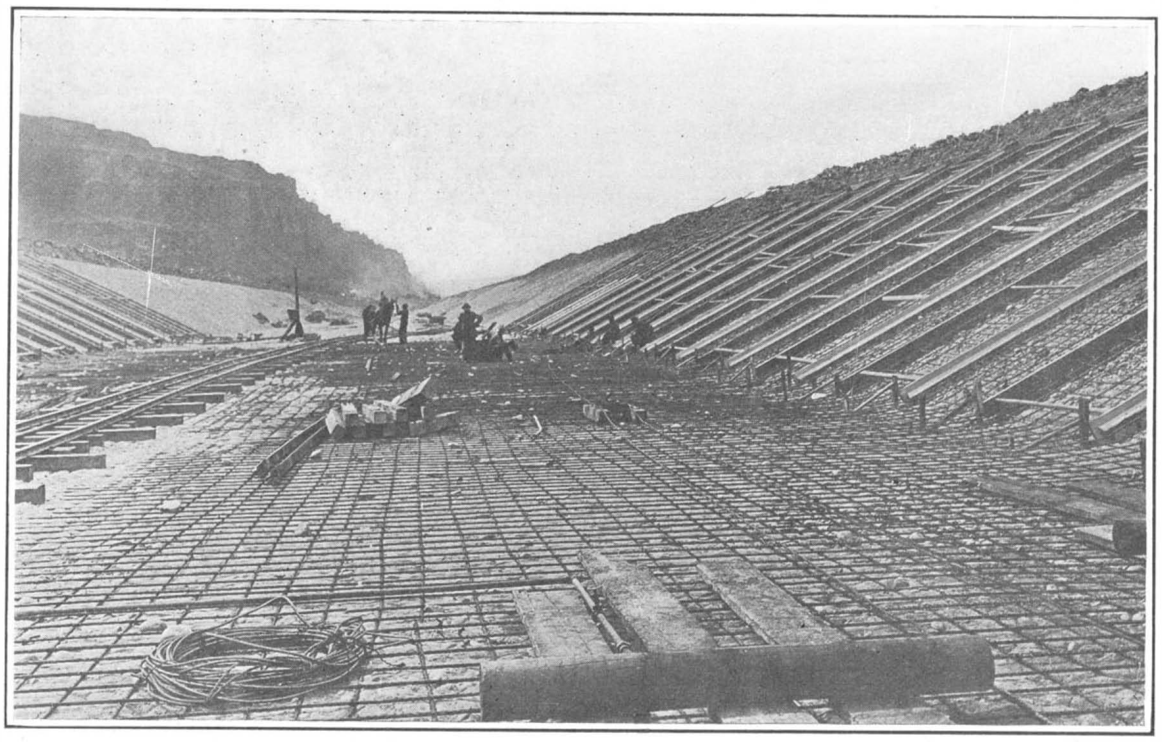
Through the operation of the canal the inland state of Idaho enters the category of commonwealths that boast a seaport, as vessels of the river sternwheel type can now navigate from the Pacific Ocean to Lewiston, head of navigation on the Snake River, the principal upper tributary of the Columbia, a distance of 480 miles.

The construction of this canal was by no means a simple task, and its successful completion reflects great credit upon our army engineers. For a length of about five miles it had to be cut through solid rock, and in some cases it was necessary to make cuts seventy feet deep.

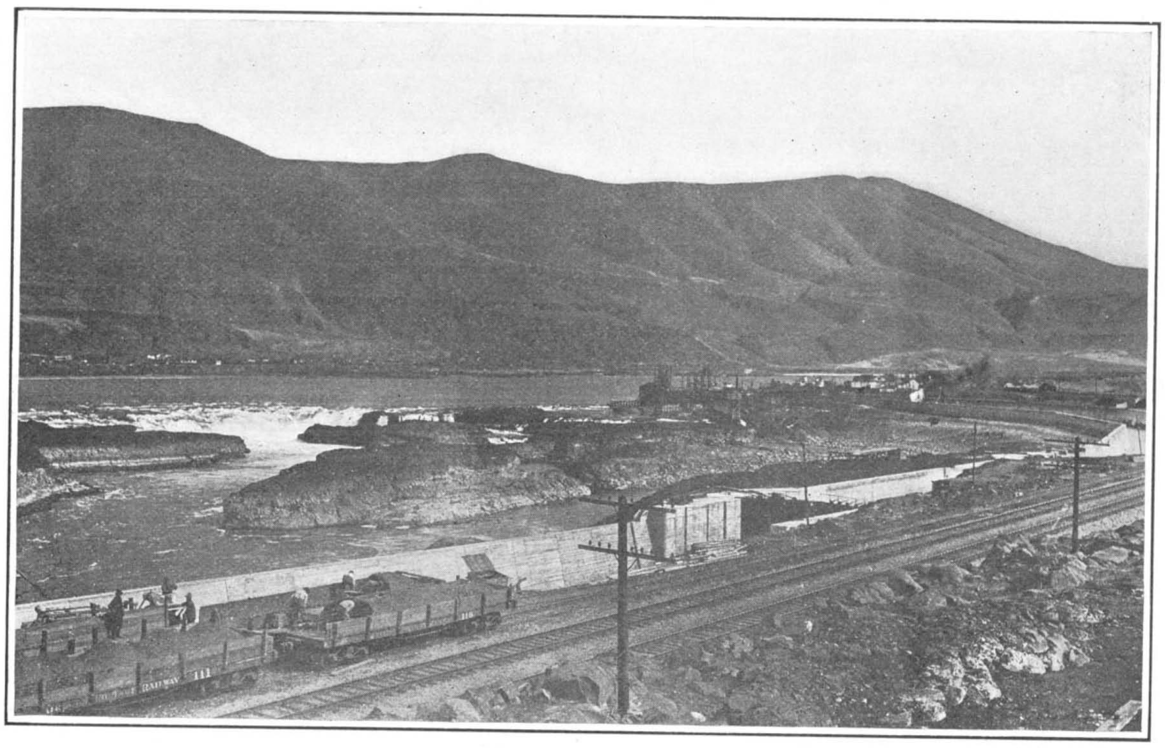
The Columbia, which is the third largest river in the country, has a drop of ninety feet in eight miles, where it passes through the Cascade Range. After a series of falls and rapids it is compelled to traverse a channel only 165 feet wide for three miles, while its normal width is almost a mile. Through this narrow crack the boiling current is 200 feet deep. Both shores are made up of lava, a solidified stream that in centuries past flowed across the wide valley and dammed the mighty river. When the engineers surveyed the site they found what was not rock was shifting sand. The rock question was merely a matter of dynamite and the sand and gravel question was settled by lining the canal with concrete reinforced by heavy steel.

This work called for the excavation of practically 1,000,000 cubic yards of solid lava rock, 504,000 cubic yards of common dry excavating, and 536,000 cubic yards of sand. As many as 1,500 men were at work at one time, and eight steam shovels, 22 locomotives and 200 cars were used. There are 5 locks, with eight passing basins. The minimum depth of water is 8 feet and the ordinary width of the canal is 45 feet. Each lock is 300 feet in length. The principal locks are at Big Eddy above the Dalles and at the lower end of the canal. There three gates serve to form tandem locks, or two locks, that give a lift of 70 feet out of the total 90-foot fall that the canal overcomes.

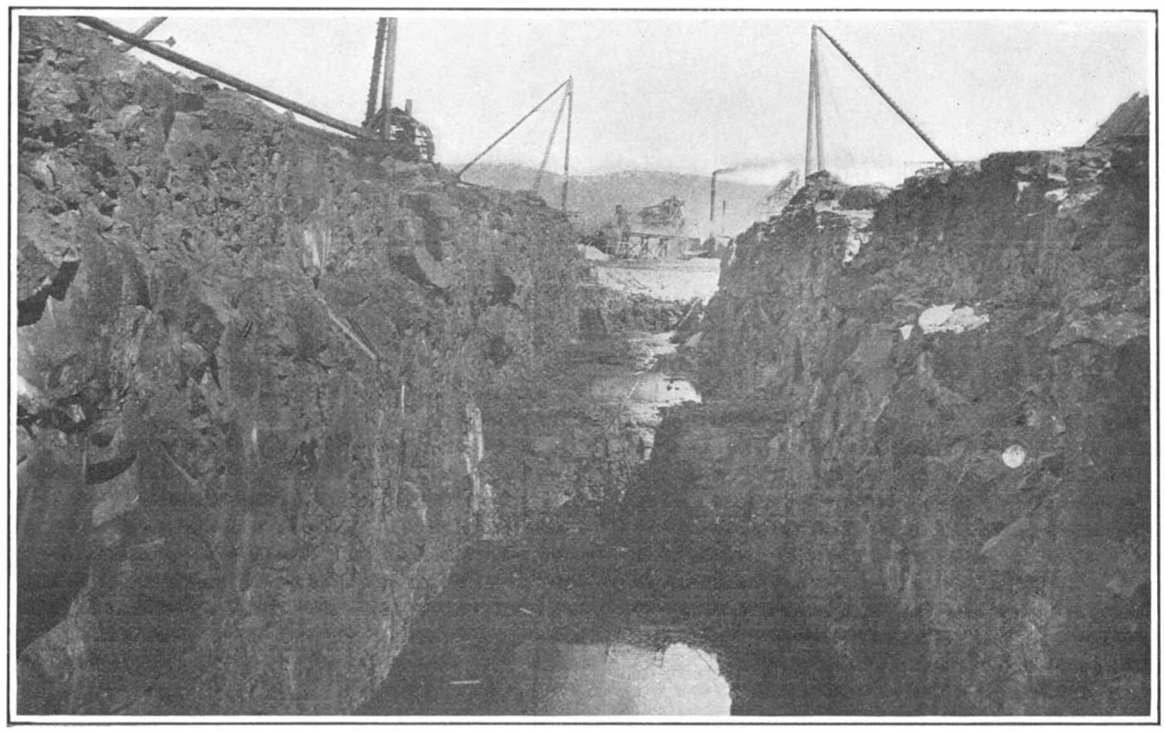
Now that the Celilo bar to navigation is overcome, the next step in freeing the Columbia as far as Revelstoke, British Columbia—1,000 miles from the ocean—will be the removal of the obstructions at Priest River Rapids, Washington and Kettle Falls. This done the Columbia will come to be numbered as the longest navigable river in the United States, except the Mississippi, and the great inland empire of the Northwest will enjoy the advantages of a waterway to carry its fruits, timber, wheat, wool, and livestock to the seaboard.



**Reinforced concrete paving through the sand belt.**



**Upper portion of the canal, showing the Celilo Falls.**



**Looking west through Five Mile locks.**

### The Miracle of Bird Migration

"THE mystery of bird migration has proved a fascinating subject for speculation and study from the earliest times," writes Mr. Wells W. Cooke in a very comprehensive and instructive publication just issued by the Department of Agriculture (Bulletin No. 185, "Bird Migration"), "but fuller knowledge has served to increase rather than to lessen interest in the subject. More persons to-day are watching birds and noting their times of arrival and departure than ever before. Indeed, the Biological Survey has received migration notes from more than 2,000 different observers. The Survey has been collecting data on bird migration for more than twenty-five years. Investigations by its field naturalists extending over the North American continent from Panama to the Arctic Circle have resulted in voluminous notes, and in addition the assistance of ornithologists throughout the country has been enlisted."

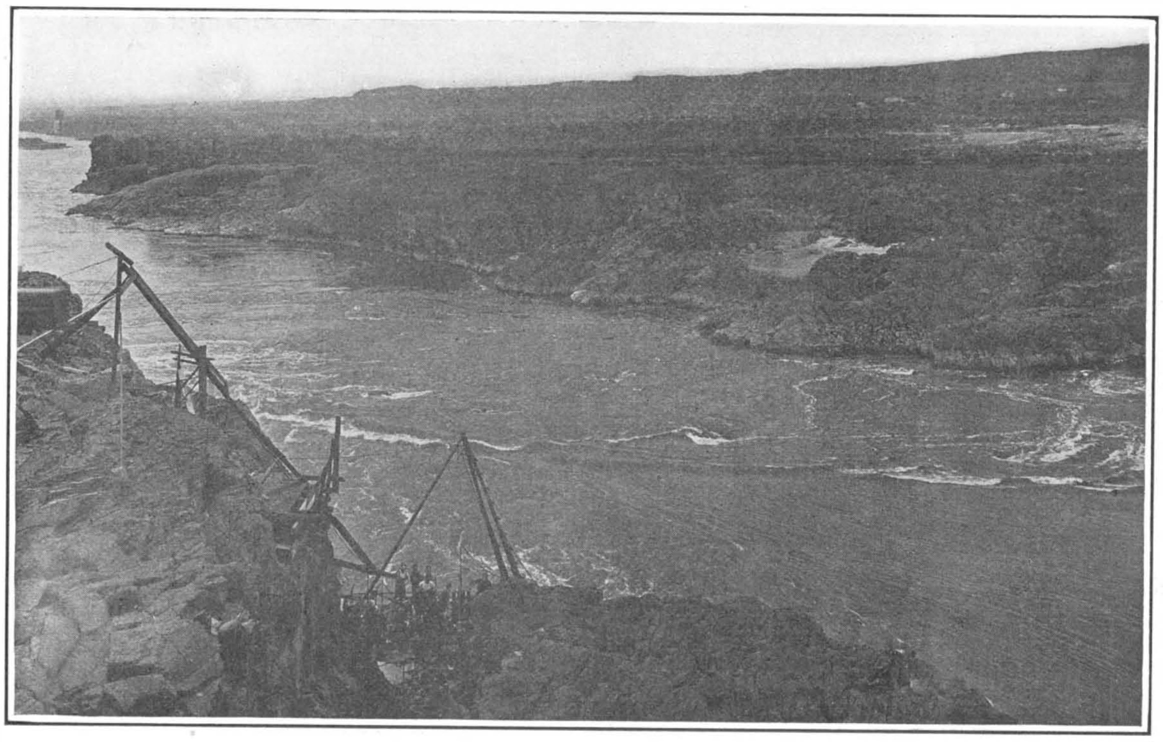
Thus, a great body of information is now available, concerning not only the migratory habits of birds in

general, but of each species separately, viz., the locations of breeding grounds and winter homes, dates and speeds of migration (the latter in many cases varying greatly for different parts of the flight), the principal routes, and the relations of all these things to meteorological and geographical conditions, the distribution of food, and other circumstances. The text and numerous charts of Mr. Cooke's memoir present this information in much detail.

The favorite highway extends straight across the Gulf of Mexico, and recent evidence disproves the old belief that after traversing this and similar stretches of water most birds are exhausted and promptly seek the ground. In fact, with increasing knowledge of bird migration, we are more and more impressed with the wonderful efficiency of the bird as a flying-machine. Of the golden plover, which in favorable weather flies 2,400 miles over the ocean from Nova Scotia to South America without a stop, probably spending some forty-eight hours on the wing, Mr. Cooke says:

"Here is an aerial machine that is far more economical of fuel, i. e., of energy, than the best aeroplane yet invented. The to-and-fro motion of the bird's wing appears to be an uneconomical way of applying power, since all the force required to bring the wing forward for the beginning of the stroke is not only wasted, but more than wasted, as it largely increases the air friction and retards speed. On the other hand, the screw propeller of the aeroplane has no lost motion. Yet less than two ounces of fuel in the shape of body fat suffice to force the bird at a high rate of speed over that 2,400-mile course. A thousand-pound aeroplane, if as economical of fuel, would consume in a 20-mile flight not the gallon of gasoline required by the best machines, but only a single pint."

How do migrating birds find their way? This is the greatest mystery of all. The familiar inhabitants of our dooryard martin boxes will return next year to these same boxes, though in the meantime they have visited Brazil, flying by night and crossing a great body of water where there are no marks to guide them. So many hypotheses have been advanced on this strange subject (one of the latest of which regards birds as natural compasses having a subtle response to the earth's magnetic lines of force), that we turn with interest to the latest authoritative opinion, as given by Mr. Cooke. Sight, he says, undoubtedly plays a part in the process, by night as well as by day. "Nevertheless something besides sight guides these travelers of the upper air." They possess a power, whatever its nature, which may be called a sense of direction. "We recognize in ourselves the possession of some such sense, though imperfect and frequently at fault."

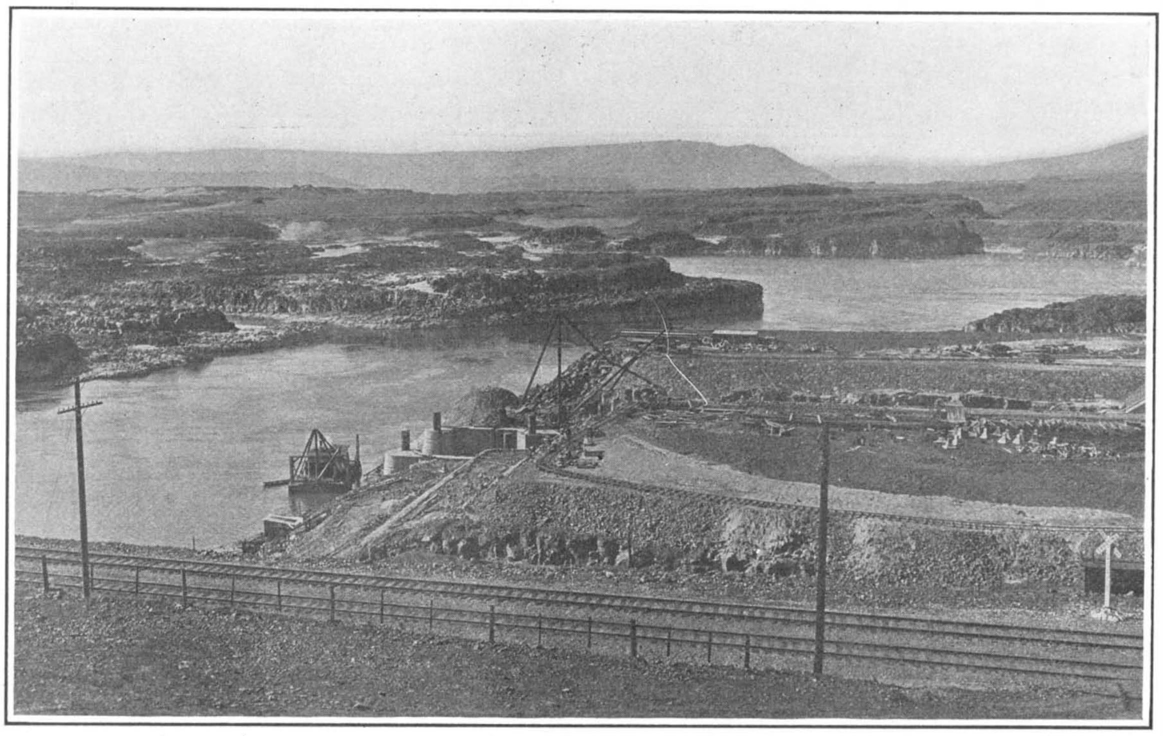


**Five Mile Rapids, where the Columbia is 165 feet wide and 200 feet deep.**

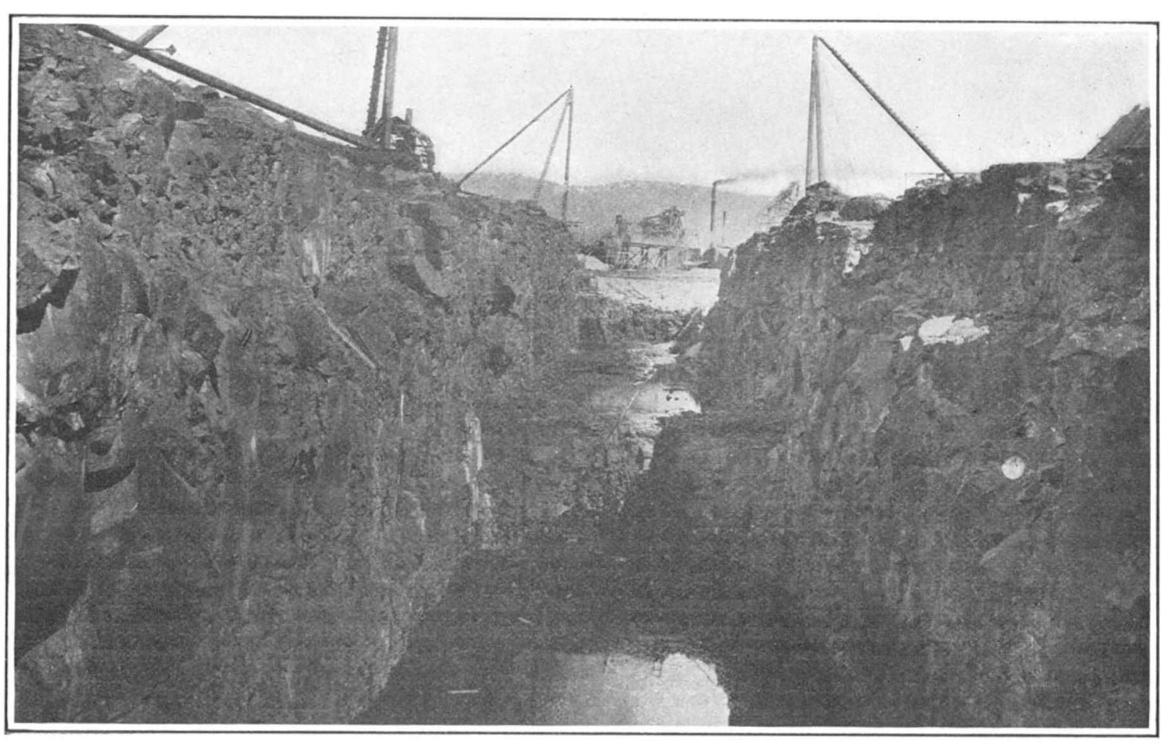
The differences between the habits of various species are striking. As to the distances covered in migration, we have at one extreme a few non-migratory species, such as the grouse, bobwhite, cardinal, and Carolina wren, and at the other that marvelous traveler, the Arctic tern, which nests within a few degrees of the north pole, and migrates thence to the borders of the Antarctic continent. The Arctic tern makes its annual round trip of 22,000 miles in barely twenty weeks of flight; hence, even if it flew in a straight line, it would need to cover more than 150 miles a day. Actually this distance is doubtless multiplied several times by zigzag twistings and turnings in pursuit of food. A noteworthy fact in connection with this bird is that it enjoys more hours of daylight and sunlight every year than any other animal on the globe. During at least eight months it lives where there is no night, and during the other four months where daylight is much longer than darkness.

The dates of migratory movements are determined by average weather rather than by that which happens to prevail during the season of migration in any particular year. Thus, migration may be said to be a question of climate and not weather. However, after a bird's travel begins the weather encountered *en route* influences the process in a subordinate way, retarding or accelerating advance by not more than a few days in the aggregate. The winds seem to have little to do with the process.

Different species affect different routes of migration.



**Lower end of the Celilo canal, showing work on the locks.**



**A 70-foot cut through solid lava at the western end of the canal.**

## Russia and Alcohol Utilization

CONSUL-GENERAL JOHN H. SNODGRASS of Moscow, reports the Russian Ministry of Finance, to promote the industrial and technical utilization of spirits for technical requirements, has decided to establish an international competition with premiums for the best inventions, which must be presented by January 1st, 1916, to the Chief Administrator of Taxes and Sale of Drinks.

The prizes are five in number and include one of 100,000 rubles ($51,150) for a new method of utilizing alcohol for making a product different from the alcohol used, such as vinegar, ether, chloroform, etc. Other prizes, approximating $38,000, $25,000, $12,000, and $2,500, are offered for new methods of utilizing alcohol as a solvent, for its utilization in smokeless powder and artificial silk; in increasing its heating value to render advantageous use of the alcohol as a fuel, and for inventions or improvements in apparatus for utilizing alcohol in internal combustion engines and for heating and illuminating purposes. Those especially interested can doubtless obtain detailed information from the Department of Commerce.

**Fire Peril in the Patent Office.**—The Washington *Times*, in a recent editorial touching the danger from fire in the various federal buildings, remarked that the Patent Office was perhaps the only public building in which there was great danger to human life and that such danger had been attested to by the Commissioner of Patents and by the District Fire Marshal. The fire danger has been called to attention in these columns.

# Our Army Wireless Automobiles

## Portable Radio Telegraph Apparatus of 200-Mile Sending Radius

By C. H. Claudy

THE Signal Corps of the United States Army has just completed its second successful wireless plant in an automobile and has now under construction a third such unit, which will be in commission in May for use in the proposed problem work in the field when the campaigns which culminated in the battle of Antietam are gone over in the field this spring.

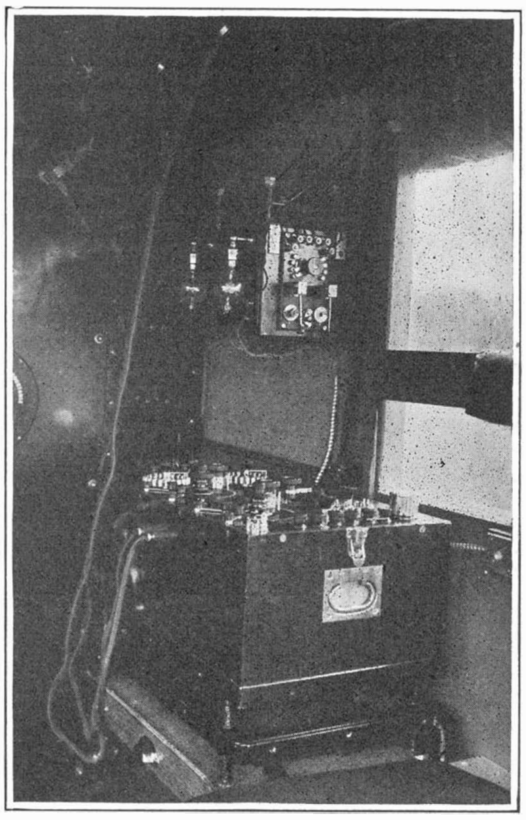
The just completed car is a 2½-ton truck chassis, with a special body, in which is built the apparatus for wireless transmission and receiving. The antenna, composed of sixteen 100-foot wires, is supported by an 80-foot mast, which can be erected in six minutes. This mast is made of artificial bamboo, a Signal Corps design, in which half round, hollowed out, sections of spruce are pinned together with glued dowells and wrapped at the joints with phosphor bronze wire. The result is a tube of great strength and lightness; and, when arranged in 10-foot lengths, a mast which can be erected and put in commission in the minimum time mentioned. The sixteen 100-foot wires have ropes at the ends which continue to the ground, forming braces. Two other sets of braces are also provided to hold the mast erect and steady in all weathers. The sending radius of the apparatus is approximately two hundred miles, varying to some extent, of course, with local conditions. The current is supplied from a 500-yard cycle alternating current generator of 2 kilowatts capacity. This generator is driven by the automobile motor, by means of special clutch built into the apparatus. As the generator requires only about 6 horse-power to drive it to its full capacity, the automobile motor uses but little gasoline for that purpose, and generates so little heat that the ordinary cooling system and fan suffice to keep it cool.

The receiving radius is practically without limit. The wireless car now in service in Texas along the Rio Grande has picked up messages from Fort Egbert on the Yukon, almost three thousand miles away. The wireless apparatus, of the quenched spark type, embodies no particularly unusual features, with the exception that it is all built in an extremely compact manner, and so constructed as to be unusually strong and thus able to resist the shocks of rough transportation. The apparatus, while using accepted ideas as far as its principles are concerned, was all designed expressly for this work by Signal Corps engineers, and constructed in Washington under their direct supervision. Commercial electrical firms, while willing to undertake such work, lack the special experience of army needs for field work and a thorough comprehension of the requirements. Experience has shown the Signal Corps that no apparatus for their special use is so satisfactory as that which they themselves design and build.

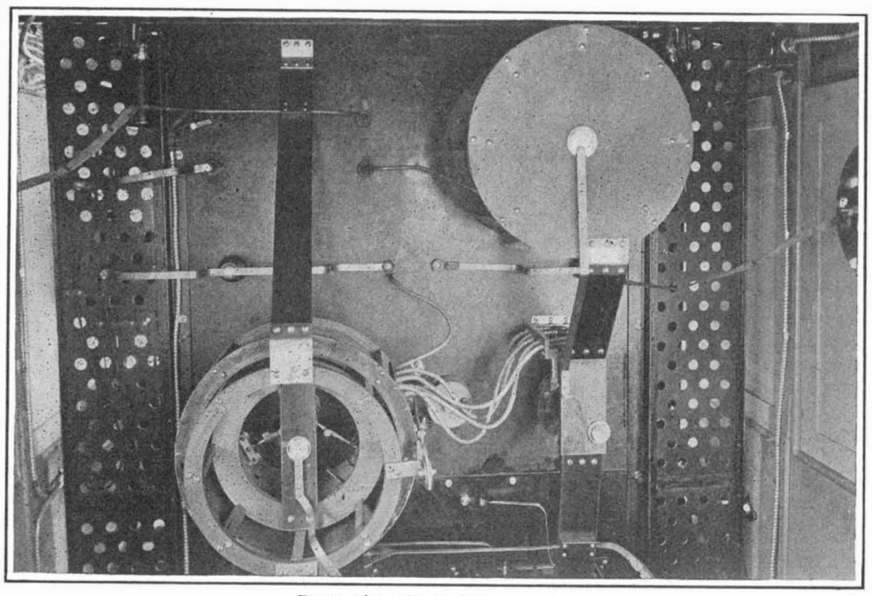
The cars are operated by a squad of ten men, of which one is designated as "chief of the section," one is driver and mechanician, two at least are skilled wireless operators, and the rest thoroughly drilled in the swift erection of the mast. In this drill every man has his duty, his special station and his particular task. Only by such a thorough understanding is it possible to dash up to a stop, unlimber the mast sections, erect the 80-foot structure and get into communication with the base of supplies in the short time of six minutes. The cars themselves, considered as automobiles, are all of different types. One is a 2½-ton truck of the ordinary construction; the other is a 2½-ton truck with the new four-wheel drive, able to go anywhere the wheels will not sink in, whether there be a road or not; and the third, and smallest car, now being rapidly finished, is a three quarter-ton truck of the ordinary drive type.

The larger cars cost, complete, about $8,000 each. They have a maximum speed of fifteen miles per hour, and carry gasoline—twenty gallons — sufficient to run the thirty-horse motors for a distance of upward of one hundred and fifty miles. It is to be noted, however, that as the gasoline must be drawn upon for generating electric power for the wireless, the effective radius is probably not to be considered as above one hundred miles of travel for any one car. According to Brig.-Gen. George P. Scriven, Chief Signal Officer, the car in service in Texas has done satisfactory work and demonstrated the wisdom of making others for the Army.

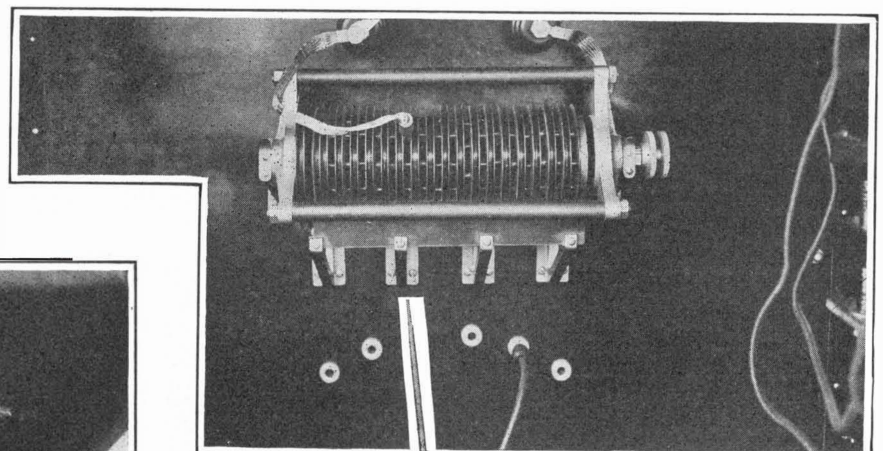
With wireless demonstrated daily abroad as being a most important element in modern warfare, it is an interesting side light on the question of the United States "preparedness" to find its Signal Corps providing itself with the most up-to-date and efficient type of apparatus for the transmitting of intelligence, and testing the units so provided in the field, with unqualified success.



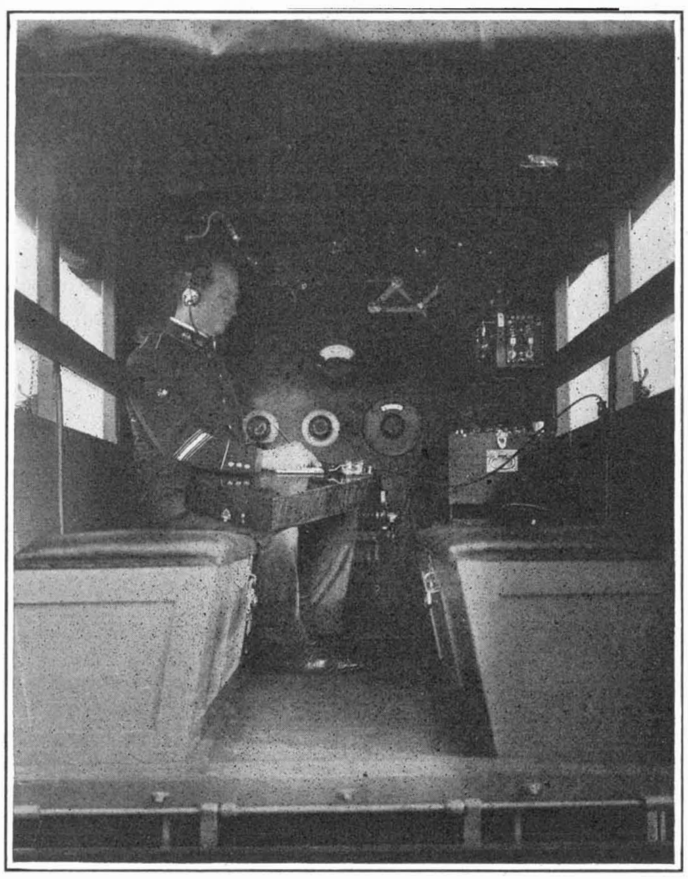
Audion receiving set.



Rear of main switch board.



Quenching spark gap.



Operator receiving message.

Erecting the sectional mast.

**A mobile wireless plant of the United States Army signal corps.**

---

**A Big Telescope for Argentina.**—A 60-inch reflecting telescope is to be constructed at Cleveland, O., for the National Observatory at Cordoba, Argentina.

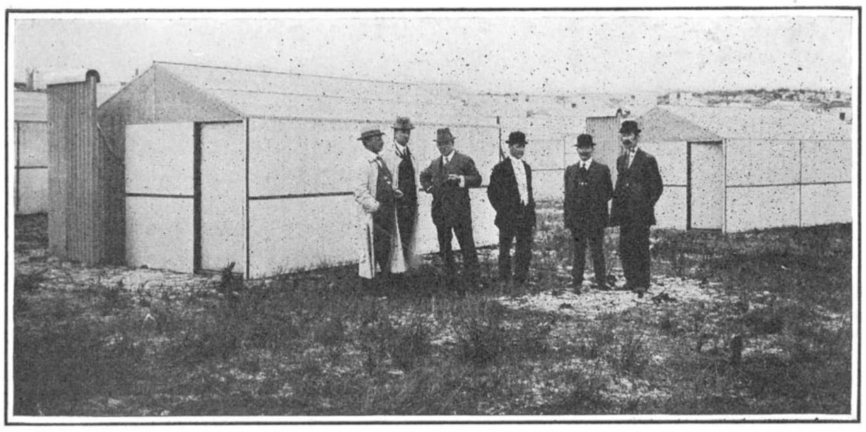
## "Canvastown" for Government Employees

BECAUSE of the considerable amount of unemployment due to the war, the New South Wales government decided to place all men employed by the government on the various construction works on four days per week. By this means an additional four thousand men were given employment without exceeding the amount spent on these works prior to the war. The loss of two days per week was a very serious matter for the men so reduced, and in view of the very high rentals charged for all sorts of habitations, it was decided to meet the reduced earnings by providing temporary dwellings at a nominal rental; hence the decision to erect canvas dwellings and to reserve them exclusively, for the present at any rate, for employees of the Public Works Department.

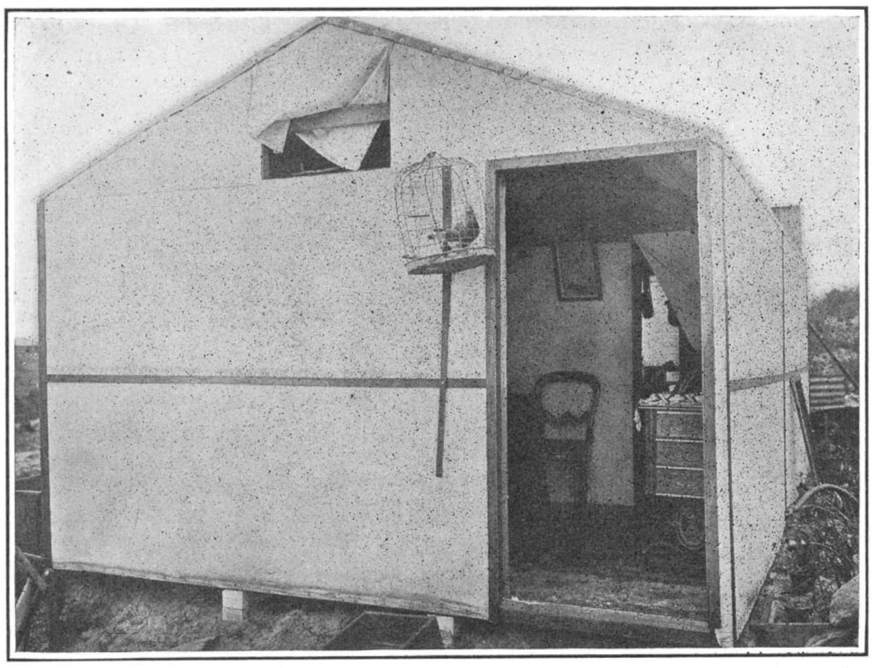
The site chosen is an open piece of Crown land country, near Sydney, and close to the trolley line. The dwellings are constructed of cloth sides (covered with a coating of paint) tacked to wooden studs, and a rubberoid roof. Each house is floored and has doors front and back, in addition to a window. Each has 20 feet of ground space, and is separated by that distance from its neighbor on all sides. The houses contain in some cases two, and in others three rooms, each measuring 8 feet by 10 feet. Electric light, running water, and proper sanitary provisions have been installed.

At time of writing 29 families were in residence, totaling 149 souls, including 93 children. School facilities are provided by the Department of Public Instruction, and a matron from the Board of Health visits the settlement once, and sometimes twice weekly, for the purpose of health talks with the mothers. A sanitary inspector has been appointed, whose services are devoted exclusively to the settlement. A public telephone has also been installed. Provision, too, has been made to supply the residents with all food requisites at wholesale prices from a government institution which adjoins the settlement.

Each two-roomed dwelling costs £10 to erect, and a rental of 1s. 6d. weekly is charged the occupier. If an extra room is added the rent is then fixed at 2s. The money derived from rent is used to defray the cost of sanitary services, water and lighting rates, repairs, etc. Should there be a surplus it will be used for further improvement on the area; therefore, the government will not benefit financially by the scheme.



An official visit to "Canvastown."



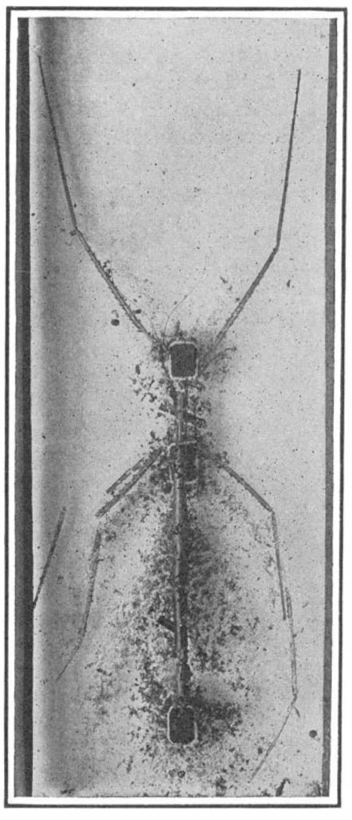
Typical "calico" house, showing part of the interior.

## Beetle Pest in Museums

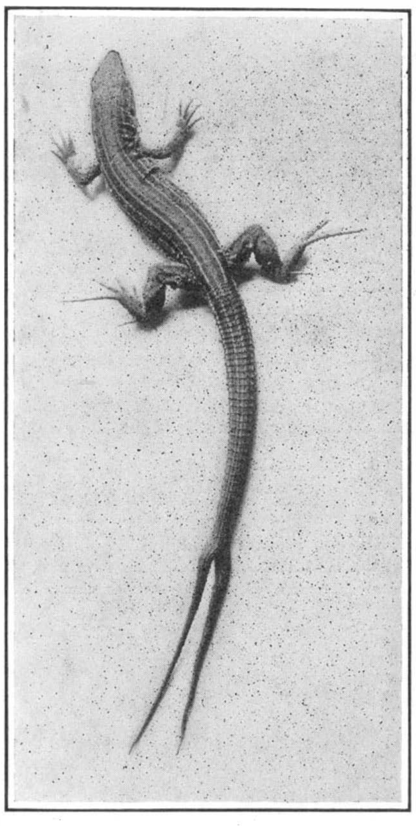
ONE of the worst enemies curators of museums have to contend with is a tiny beetle which works so neatly that there is no evidence of its woeful work until the specimen is found dismembered or otherwise ruined. Neither in America or England has any effectual remedy been found.

The tiny mischief-worker is the *Anthrenus museorum.* The adult measures only, or even less than, one eighth of an inch in length, and is convex in form. The female lays eggs in specimens and the larvæ feed on them—the valued butterfly and the magnificent beetle—brought from afar. These larvæ are small plump, hairy grubs, and the sole sign of their presence, likely to be overlooked by the amateur, is a few specks of brown dust in the case.

The illustration shows a 14-inch stick insect, from Assam, in the collection of Dr. Howard Kelly, which seemed in good condition one day, and the next was found as shown.



Specimen of stick insect destroyed by beetle larvae.



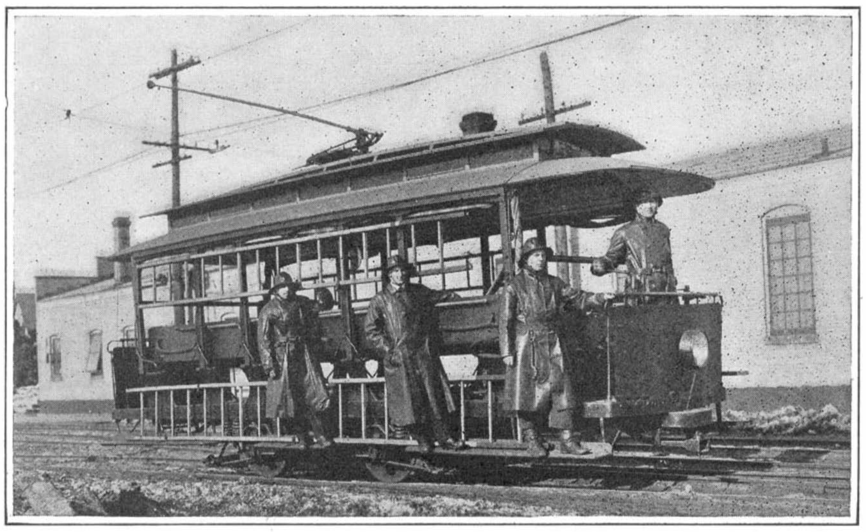
Growing two tails to replace an injured original.

## A Fire-fighting Trolley Car

THE accompanying illustration shows a fire-fighting trolley car in service at Duluth, Minnesota, as a part of the equipment of its fire department. An unusual condition was responsible for the "partial trolleyization" of the fire-fighting equipment. The harbor of Duluth is formed by a narrow strip of land extending across the western end of Lake Superior. This strip of land, only four to six hundred feet in width, extends for a distance of seven miles from the Minnesota to the Wisconsin shore. About three miles of it, extending from the Duluth shore, is built up. Many of the cottages are merely summer homes, but others are permanent residences of comparatively expensive construction. Park Point is cut off from the city proper by the entrance to the harbor, spanned by an aerial bridge. Crossing the bridge is sometimes a slow process—slow compared with the dispatch necessary in response to a fire alarm. But that is not the main obstacle to reaching the houses on Park Point with fire-fighting apparatus. This suburb is so narrow that only one street is laid out. The car tracks are laid in that street, the surface of which is beach sand, loose and shifting and offering no foundation to team travel. The fire-fighting problem proved a difficult one for many years. Bucket brigades did what they could, but when a house on Park Point took fire the chances were ten to one that it would burn to the ground. Insurance rates were high, permanent residence was discouraged and cheap construction encouraged.

A fire tug would solve the problem under ordinary circumstances, but the water along the shore is so shallow that a fire tug could not approach. Finally the idea of the trolley fire department was considered and the co-operation of the street railway company was obtained. A car that was in good condition, but had served its usefulness as a passenger car, was purchased. The seats were taken out and the braces retained. A hose box was installed the whole width of the car. It was left open at both ends, so that no matter which way the car is going it can carry the hose line from the hydrant to the point of the fire. The equipment consists of 1,500 feet of 2½-inch hose, a set of ladders, axes, and pike-poles, two six-gallon Babcock extinguishers, extra charges, rubber coats and hats for volunteers.

The car is stabled near the main offices of the company, so there is always a motorman on hand to respond to an alarm. When an alarm is turned in from Park Point the car is started down the tracks immediately, and has absolute right of way. An automatic electric gong is cut in as soon as the car starts, so that all along the Point notice is given that a fire alarm is being answered, and volunteers are picked up on the way.



The fire-fighting trolley car of Duluth, Minnesota.

## A Two-tailed Lizard

THE accompanying photograph of a lizard with two tails was sent to the Editor of the SCIENTIFIC AMERICAN by George F. Mims, who found the curious specimen in the vicinity of Edgefield, S. C. The photograph was referred to Dr. Raymond L. Ditmars of the New York Zoological Park. His comment on the specimen is as follows: "While we occasionally see lizards with two tails, this appears to be a remarkable case of reproduction. The growing of two tails is caused by a portion of the original tail being broken off. With lizards an injury to the tail is always repaired within a few months. A repair sometimes results in the formation of a fork appendage, but rarely of such symmetry as shown in this photograph. The species of lizard shown is known as a race-runner. Its scientific name is *Cnemidophorus sexlineatus.* Lizards of this type live in dry, sandy places, and are very quick in running. An injury to their tail is often caused by hawks dashing at them and, owing to the lizard's agility, being able to seize no part of the reptile but its tail."

---

**Patented Razor Blade Box.**—King Camp Gillette of Brookline, Mass., in a patent, No. 1,132,925, issued on an application filed in October, 1898, seeks to protect the small metal box for holding Gillette safety razor blades and which has a telescoping cap or closure designed to form a hermetic joint with the body portion of the box.

## Visible Speech

(*Concluded from page 471.*)

fifth of a second. This is an entirely abnormal and unexpected feature; and the remarkable thing is that such a difference should be heard as one similar to the difference between English *d* and *t;* and yet such is undoubtedly the case. In short, sounds, like many other things, are not always what they seem.

**Releasing Through the Nose.**

One of the most curious classes of sounds are the *p, t,* and *k* coming at the end of the words in this same Marshall Island dialect, and in certain of the southern dialects of the Chinese languages. It will be seen from Fig. 4 that in the record from the mouth the sudden sharp rise or mountain which normally marks the end of *p, t,* and *k* in other tongues is entirely lacking; instead, there is a smaller rise in the tracing from the *nose* at about the point where it would be expected in the mouth record. The Canton Chinaman, in short, when he speaks his word for duck, *ap,* puts his lips together as we would on commencing the *p,* but *fails to take them apart*—at least until the next word compels him to do so. Instead, by a motion of the uvula, he opens the passage leading from the back of the mouth into his nose and allows the air impounded by the lips to escape through his nostrils. The result, as anyone who has carefully listened to the sounds of this dialect can detect, is a peculiar one, the native appearing at one time to say *ap* and another time merely *a'*. Actually he does neither, but ceases all further effort after he has completed the first half of the consonant.

Sounds are very much like human beings. Each of them represents an ideal type which is rarely or never attained. The actual utterance of each sound is determined very largely by the sounds with which it is in contact. Very much as twin brothers with identical temperaments and dispositions, on being reared in families of different circumstances and social station, may turn out to be men of totally diverse character, so with the sounds of human speech. One of our boys may grow up to be a statesman, the other a criminal, not through any inherent difference between them, but through the mere force of environment and associations.

Fig. 6 shows two such absolute "twin brothers of speech" that have pursued very distinct careers. In this instance it can literally be said that the two *g's* are twins, because the word *gogo,* which in the Marshall Kanaka dialect denotes a species of fish, is a reduplicated term from the root "*go.*" One *g* should therefore in theory be like the other. A glance at the tracing reveals the fundamental difference between them.

**"Evil Associations."**

A similar influence of associates is revealed in the Papago Indian tracings of Fig. 10, the upper of which shows the singular form of the word for "child," the lower the reduplicated extension of the same term when it is plural. In the singular, *alih,* the first vowel is long and accented, but fully voiced or sounded, that is, produced with vocal cord vibration. It imparts this quality to the following consonant *l,* which in turn lends the same trait to the second vowel *i.* When, however, "children," *a'ali,* are denoted, the added prefixed syllable takes the accent and is followed by a period of complete silence (indicated by the apostrophe). The original *a,* now in second place and much weaker, is marked by vocal cord vibrations barely to its end. The voice or sounding having died away in this vowel by the time it is concluded, the following *l* is unsupported and therefore silent; that is, like Welsh *ll,* unvoiced. Finally, the *i* is also reduced to entire "silence" or surdness. It is true that the *l* and *i* in the second instance are not inaudible like the so-called "silent" letters of English spelling. They are actually present, but the withdrawal of the vocal cord vibrations to which we are accustomed gives them the character of little more than a noisy rushing and a breath.

**A Sniffed Sound.**

Just so the silent *m* in Fig. 5 is not to be understood as a non-existent or unpronounced sound. It is a surd *m*, silent only in the same sense of the vocal cords being at rest during its formation. This, however, is so anomalous to the ear accustomed to the English speech that the *m* is barely audible as a sort of sniff through the nose while the lips are shut. The Papago language is peculiarly rich in such "silent" sounds. In fact, every letter that it possesses appears in both the "sounded" and "silent" forms, a quite unusual circumstance.

Not all the experimental determinations in the science of phonetics are made by the kymograph. Numerous "mouth explorers" and other ingenious appliances have been used to supplement the apparatus. Some of these have yielded pretty results; but the simplest and at the same time most productive are two—the camera for the outside of the mouth and the false palate for the inside.

**Writing on the Roof of the Mouth.**

The "false palate" is grandfather's "plate" with the teeth left off, and extended somewhat farther back to the rear of the mouth. A cast of the roof of the oral cavity is taken, and from this is made a thin sheet of aluminium, vulcanized rubber, or dental compound, reaching from the edge of the gums to the soft palate. This sheet is the "false palate." Slipped into the mouth and gently pressed upward, it coats the surface of the natural palate like a tight glove, and does not seriously interfere with pronunciation. It is dusted with chalk or powdered soapstone. The subject of the experiment then speaks the desired word or sound. Wherever his tongue touches his palate in this act, the saliva licks off the white chalk, exposing the red or black surface of the artificial sheet. This is then removed and the white and dark areas sketched, or in important cases photographed. The dark regions represent the portions of the gums or palate against which the tongue "articulates" for any given sound.

As might be expected from what has been said before, the "same" sound in different languages is often produced in sufficiently distinct portions of the mouth to be not really the same. Hupa Indian *l* and English *l*, for instance, are formed, respectively, forward and to the rear (Fig. 3); and in the same way English *s* is proved to be nearer *th* than Hupa *s*.

Just so, in one and the same language, there are often two sounds made in the same way, but in such closely adjacent parts of the mouth as to be distinguishable with difficulty. Papago Indian *s* and *sh* are considerably more alike than English *s* and *sh*. Among us, a man coming home late may explain to his wife how he has been to "shee a shick fren"; but in Papago and many other Indian idioms such pronunciations seem, to the English ear, to be typical even of unalcoholized conversation. Of course, the confounding is in the perceiver, not in the speaker, as the "palatograms" or false palate records of Papago *s* and *sh* in Fig. 2 demonstrate. In the same way, this language possesses two baffling *t* sounds, which may be represented by *t* and *t*, and which the false palate quickly reveals as being formed just like English *t*, except that in one the tongue touches a little nearer the front teeth and in the other a little farther away from them.

**A Life for a Letter.**

Such differences may seem immaterial, but are sometimes fraught with the gravest meaning. The intrepid English explorer, Doughty, relates how when alone among the Bedouins of the Arabian desert he was called in to aid a sick chieftain, his ability to read and write being enough, in the minds of this unlettered folk, to endow him with a knowledge of all the arts and sciences, including medicine. As he emerged from the tent, the sheik's anxious followers inquired his condition. "His heart still lives" was the reassuring reply which the Englishman made or thought he made in the Arabic language; and he was startled to see every man reach for his gun or knife. It was only when a

cooler head realized that the well-meaning but ignorant foreigner had probably meant "heart" when he had really said "dog" (*qelb*, with the *k* [*kelb*, as in English] pronounced far back in the throat as only a native Arab can do it), that the excitement subsided. "The dog still lives" was surely a statement that a loyal Bedouin had a right to resent when uttered about the head of his clan.

Lip photographs are even more easily made, and no less instructive, since they fix permanently a characteristic position that the eye is able to observe for only a fraction of a second. Each vowel, from "rounded" *u* down the series to "flat" *a* and back again to "narrow" *i*, has its typical lip posture as well as interior tongue position. In fact, these lip and tongue placings are all that distinguish any vowel from any other. It is, therefore, remarkable how much variation of vowel tone the American Indians are able to produce with the extremely slight shifting of lip positions which they employ in their ordinary speech. Paiute, Hupa, and other tribal records from the most different individuals, young and old, regularly show this phenomenon. The old Mohave, whose stolid, tense mouth is shown on the right of Fig. 8, scarcely altered the aperture of his mouth in pronouncing the five vowels of his native idiom. The left half of the same figure reveals the large mobile lips of the interpreter, an unusually quick-witted man, who seemed instinctively to grasp the purport of the investigation, and, more like a skilled actor than an old-fashioned Indian, enunciated with the utmost vigor and clearcutness of motion. The long slit of his *i* differs as thoroughly from the gaping cavern of his *a* as from the snout-like protrusion of his *u*, almost resembling a telescope photograph of a lunar crater. He spoke for the camera much like a Frenchman "over-pronouncing" his English. Such freedom of lip motion is, however, untypical of his tribe as well as of the Indian in general, whose normal tendency is to slur and sloven his vowels and often his consonants, this being, perhaps, the most characteristic difference between civilized European and aboriginal American speech.

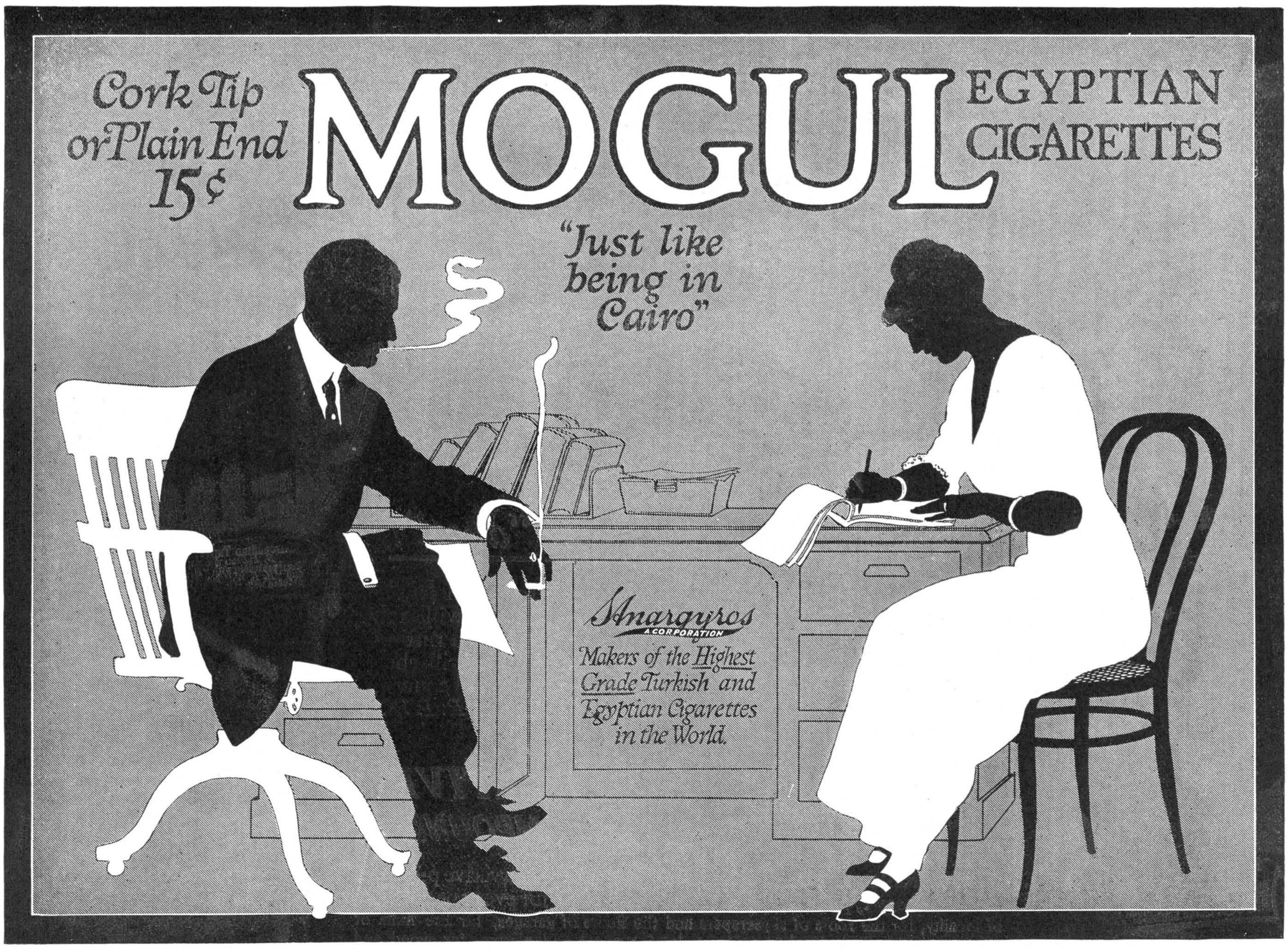
### The Energy of Projectiles

THE German infantry rifle M-98 takes a powder charge of 3.2 grammes, the explosion of which produces 2,762 gramme-calories of heat, equivalent to 1,170 meter-kilogrammes (8,463 foot-pounds). Nearly one third of this energy is consumed in giving the bullet its initial velocity of 820 meters (2,690 feet) per second, and nearly one quarter is used in heating the rifle barrel. The rest of the energy, about 45 per cent, is represented by the hot gases and the report. The bullet traverses the barrel in about 1/2000 second, during which period the pressure inside the barrel is 3,500 atmospheres.

The projectile of a 16-inch gun possesses a kinetic energy of 300 million foot-pounds, equal to that acquired by a granite block 33 feet square and 17 feet thick in falling 100 feet. The projectile of the Krupp 30.5 centimeter (12.2-inch) naval gun weighs 445 kilogrammes (980 pounds) and has a muzzle velocity of 820 meters (2,690 feet) per second.

Its range is about 20 kilometers (12.4 miles) and it travels this distance in about 95 seconds. If the gun were pointed exactly north or south the lateral deviation of the projectile, due to the earth's rotation, would amount to 160 meters (525 feet).

**Likely to Confuse or Deceive.**—In Rockwood Pottery Company v. The A. Wilhelm Company the Court of Appeals in affirming the decision of the Commissioner of Patents in referring to the suggestion of appellee's counsel that the notice was subject to dismissal because it did not allege that confusion had actually occurred, as without merit, said: "The statute is prospective in that it forbids the registration of a mark which is likely to create confusion in the public mind or is likely to deceive purchasers. It is not necessary that actual confusion be shown; the mere probability of confusion is sufficient."


Cork Tip
or Plain End
15¢
MOGUL
EGYPTIAN
CIGARETTES
"Just like
being in
Cairo"
Anargyros
A CORPORATION
Makers of the Highest
Grade Turkish and
Egyptian Cigarettes
in the World.


GOOD NEWS for all Friends and
Admirers of Egyptian Plain End Cigarettes
MOGUL EGYPTIAN
CIGARETTES
MOGUL
EGYPTIAN
CIGARETTES
Anargyros
A CORPORATION
SELECTED
TURKISH
TOBACCO
the most delectable of all Mild
cigarettes may now be had
PLAIN END
In the convenient FLAT BOX
with the PROTECTIVE INNER
FOIL and OUTER LINEN
WRAPPER. 15¢
Anargyros
A CORPORATION
Makers of the Highest Grade Turkish
and Egyptian Cigarettes in the World.


DRY DOCK No. 4
NEW YORK NAVY YARD
Waterproofed with 400,000 lbs. of "R. I. W." Toxement.


PEDRO MIGUEL LOCKS
Panama Canal
Protected against electrolysis and rust by "R. I. W." Tockolith, "R. I. W." No. 1379 and "R. I. W." No. 49.


Metropolitan Tower, New York City
*N. LeBrun & Sons, Architects*
Steel protected with "R. I. W." Tockolith and "R. I. W." No. 112. Walls damp-proofed with "R. I. W." No. 232.


The Woolworth Building, New York
*Cass Gilbert, Architect*
Steelwork, metal lath, foundations, and dome protected with "R. I. W." Nos. 110, 112, Toxement, Cement Filler, Cement Floor Paint (pat'd) and Verte Antique.

# *Steel need not rust!*
# *Wood need not rot!*
# *Nor concrete "dust"!*

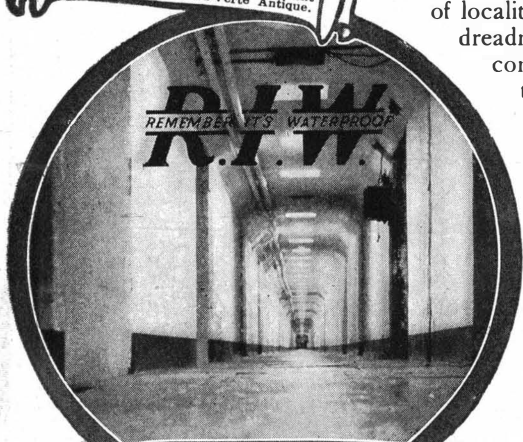
THIS is an advertisement to the engineer, the architect, the contractor, and the man-who-pays-the-bills. We will show these men that the millions of dollars wasted through rusting, rotting and crumbling are *needlessly* wasted. We will show them that the preservation of structural steel, wood and concrete is a simple matter of painting with the specific Toch "*R. I. W.*" Paint or Compound for the purpose.

## R.I.W. (REMEMBER IT'S WATERPROOF) PRESERVATIVE PAINTS AND COMPOUNDS

THERE'S an "*R. I. W.*" for every possible preservative purpose, for every type of material used in building, for every peculiarity of locality, for the roofs of skyscrapers and the floors of garages, for the hulls of dreadnaughts and the locks of canals, for metal and plaster, for wood and concrete, for the tropics or the north, for salt air or furnace fumes and a thousand other contingencies of service familiar and unusual.

Something somewhere in your present or proposed buildings is or will be rusting, rotting, crumbling to decay. There's a Toch "*R. I. W.*" Paint to prevent it. We point to the many world-prominent structures protected and preserved by "*R. I. W.*" Paints and Compounds as our authority of accomplishment which serves as guarantor for the newest "*R. I. W.*" *specific*:—


HOTEL McALPIN, New York City
*Frank Andrews, Architect*
Stone damp-proofed and stain-proofed with "R. I. W." No. 110. Mortar joints colored with "R. I. W." "Edinburgh" Mortar Color.




4¼ MILE GALLERIES
Panama Canal
Floors protected with "R. I. W." Cement Filler and "R. I. W." Cement Floor Paint (patented).

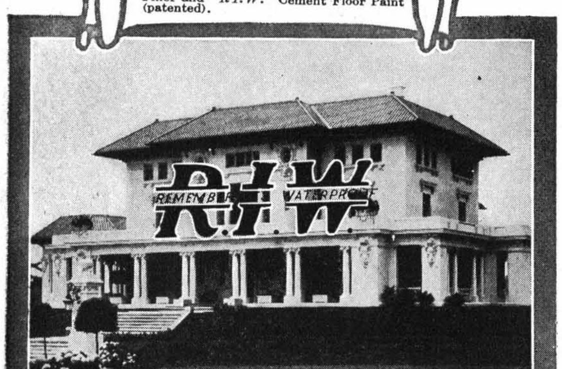
## R.I.W. (REMEMBER IT'S WATERPROOF) DUSTOP (Patent Applied for)
### *Stops Dust On Concrete Floors*

DUSTOP perfects the concrete floor. It stops dusting, crumbling and disintegration. It prevents absorption of oils and grease which are death to concrete. It reduces wear and doubles the life of any concrete or cement floor. Dustop is a transparent liquid which can be applied by anyone with a mop or brush or broom—and can be walked over after a few hours. Dustop is free of paraffine or machinery oils and does not scuff off or track on the floor. If interested, write for booklet, or

**Send Us $1.50 for Trial Gallon**

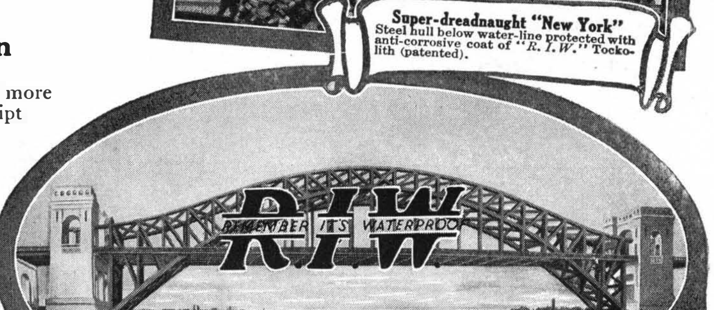
WE or our nearest distributor will deliver one or more gallons of Dustop at $1.50 per gallon upon receipt of the coupon below and the correct amount. Write for the Toch Red Book, a plain, practical treatise on preservative paints.


Super-dreadnaught "New York"
Steel hull below water-line protected with anti-corrosive coat of "R. I. W." Tockolith (patented).




RESIDENCE, ELBERON, N. J.
*J. H. Freedlander, Architect.*
Damp-proofed and decorated with "R. I. W." Liquid Konkerit.

**Toch Brothers** Established 1848
*Inventors and Manufacturers of Preservative Paints and Varnishes*
**320B Fifth Avenue, New York City, U. S. A.**
*Works, Long Island City, N. Y., and Toronto, Canada*
*Distributing agents throughout the world*




HELL GATE BRIDGE, N. Y.
Steel work protected from rust, corrosion and electrolysis by "R. I. W." Tockolith and "R. I. W." No. 49.


PENNSYLVANIA TERMINAL, New York
*McKim, Mead & White, Architects*
Steel, granite, concrete and cement floors damp-proofed, stain-proofed, decorated, protected by "R. I. W." Tockolith, Liquid Konkerit, Cement Filler, Cement Floor Paint, and No. 49.


**DUSTOP COUPON**

**Toch Brothers, 320B Fifth Ave., New York City**

Gentlemen:—I enclose check / money-order for $__________ in full payment of ________ gallons of "*R. I. W.*" Dustop (patent applied for), the newest "*R. I. W.*" preservative compound, at $1.50 per gallon. (*If not ready to try Dustop, write the word "Booklet" across coupon, fill out and mail today*).

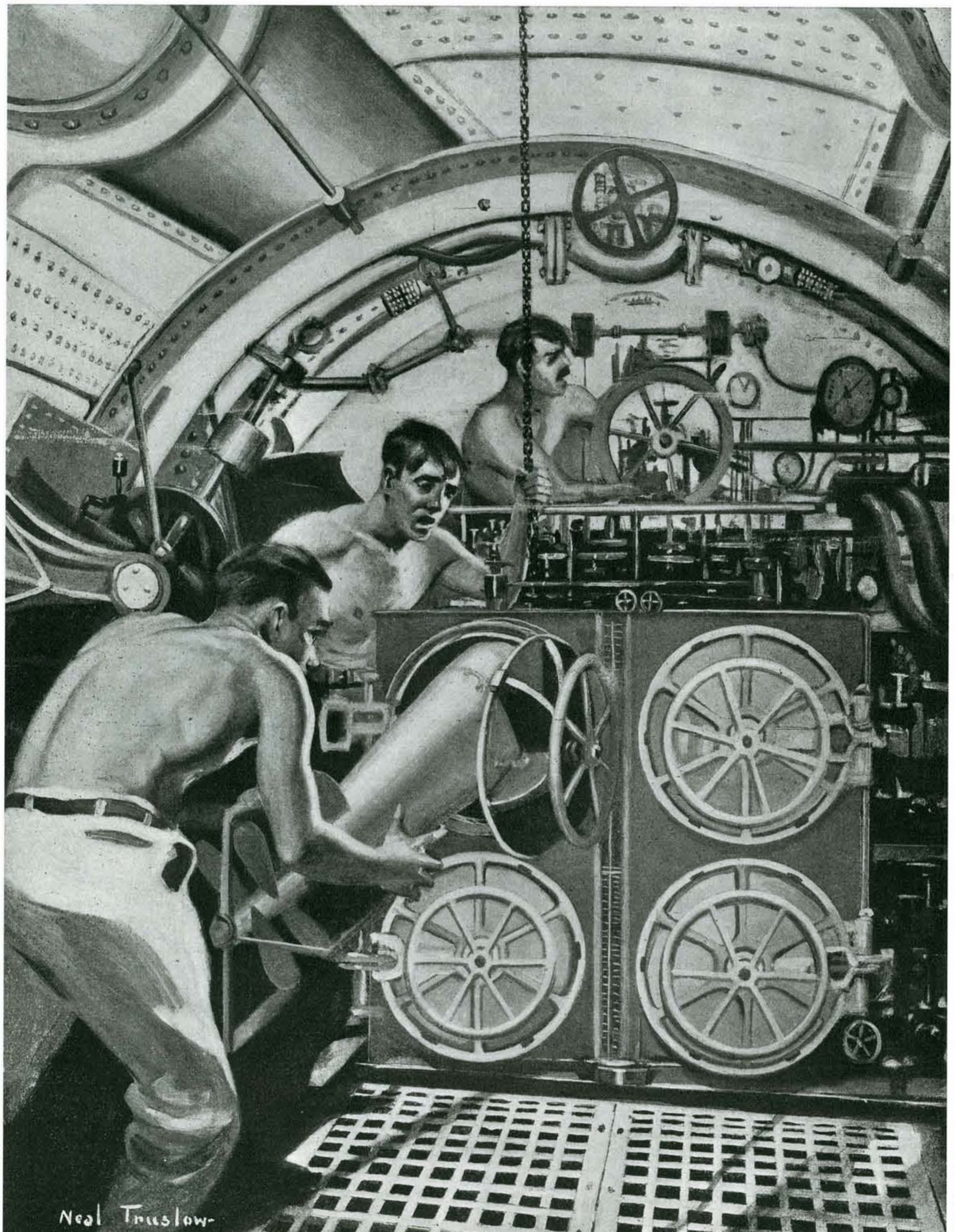
Signed ____________________

Firm ____________________

Address ____________________

Ship via ____________________

# SCIENTIFIC AMERICAN




LOADING A TORPEDO INTO ONE OF THE FOUR FORWARD TUBES OF A SUBMARINE.—[See page 493.]

Vol. CXII. No. 22
May 29, 1915

Munn & Co., Inc., Publishers
New York, N. Y.

Price 10 Cents
$3.00 A Year

# VALUABLE BOOKS

## *of Instruction and Reference*

### *Scientific American Cyclopedia of Formulas*

Edited by ALBERT A. HOPKINS. 6½x8¾. 1077 pages, 200 illustrations. Cloth, $5.00. Half morocco, $6.50.

¶ The most complete book of receipts published, containing about 15,000 selected formulas, covering nearly every branch of the useful arts and industries. Never before has such a large collection of formulas, useful to everyone, been offered to the public. Almost every inquiry that can be thought of relating to formulas used in the various manufacturing industries will be found answered in this volume. Those in search of salable articles that can be manufactured profitably on a small scale, will find hundreds of excellent suggestions.

### *Concrete Pottery and Garden Furniture*

By RALPH C. DAVISON. 5¼x7½. Cloth. 196 pages, 140 illustrations. Price, $1.50.

¶ This book describes in detail, in the most practical manner, the various methods of casting concrete for ornamental and useful purposes. It tells how to make all kinds of concrete vases, ornamental flower pots, concrete pedestals, concrete benches, concrete fences and many other objects of cement for the adornment of the home or garden. A valuable chapter on color work is included.

### *Scientific American Reference Book*

Edition of 1914. Compiled and edited by ALBERT A. HOPKINS and A. RUSSELL BOND. 5¾x7¾. Cloth. 597 pages, 1000 illustrations. Price, $1.50.

¶ A handy, compact, reliable and up-to-date volume for every-day reference, containing a remarkable aggregation of facts, statistics and readable information along industrial, commercial, scientific and mechanical lines of general interest. It is a revelation of facts and figures, and will prove invaluable on the desk of the business man, as well as the library of the home.

### *Experimental Science*

Elementary Practical and Experimental Physics. By GEORGE M. HOPKINS. 2 volumes. 6¼x9¼. Cloth. 1100 pages, 900 illustrations. Price, $5.00.

¶ This work treats on the various topics of physics in a popular and practical way and contains a fund of trustworthy scientific information presented in a clear and simple style. The aim of the writer has been to render physical experimentation so simple and attractive as to induce both old and young to engage in it for pleasure and profit. In the latest edition the scope of the work has been broadened, presenting the more recent developments in modern science.

### *Handy Man's Workshop and Laboratory*

Compiled and edited by A. RUSSELL BOND. 6x8¼. Cloth. 467 pages, 370 illustrations. Price, $2.00.

¶ A compilation of hundreds of valuable suggestions and ingenious ideas for the mechanic and those mechanically inclined. The suggestions are practical and the solutions to which they refer are of frequent occurrence. It may be regarded as the best collection of ideas of resourceful men published, and appeals to all those who find use for tools either in the home or workshop.

### *Monoplanes and Biplanes*

Their Design, Construction and Operation. By GROVER CLEVELAND LOENING, B.Sc., A.M., C.E. 6¼x8¼. Cloth. 331 pages, 278 illustrations. Price, $2.50.

¶ This work covers the whole subject of the aeroplane, its design and the theory on which the design is based, and contains a detailed description and discussion of thirty-eight of the more highly successful types. It is a thoroughly practical work, and invaluable to anyone interested in aviation.

*WE SEND THESE BOOKS BY MAIL OR EXPRESS PREPAID UPON RECEIPT OF THE ADVERTISED PRICES. OUR CATALOGUE OF SCIENTIFIC AND TECHNICAL BOOKS SENT FREE ON REQUEST. SEND US YOUR ORDER OR REQUEST TODAY*

**MUNN & CO., Inc., *Publishers*    233 Broadway, New York, N. Y.**

---

JUST PUBLISHED!    1914 EDITION.

# QUESTIONS AND ANSWERS

RELATING TO MODERN

## AUTOMOBILE DESIGN, CONSTRUCTION, DRIVING AND REPAIR

By VICTOR W. PAGÉ, M. E.

Author of "The Modern Gasoline Automobile," "The Modern Gas Tractor," Etc., Etc.

**5¼x7½ Inches. 622 Pages. 329 Illustrations. 3 Folding Plates. Cloth.**

**PRICE, $1.50, *Postpaid***

**A SELF-EDUCATOR ON AUTOMOBILING WITHOUT AN EQUAL**


**THIS practical treatise consists of a series of thirty-six lessons, covering with nearly 2000 questions and their answers—the automobile, its construction, operation and repair. The subject matter is absolutely correct and explained in simple language. If you can't answer all of the following questions, you need this work. The answers to these and nearly 2000 more are to be found in its pages.**

Give the name of all important parts of an automobile and describe their functions? Describe action of latest types of kerosene carburetors? What is the difference between a "Double" ignition system and a "dual" ignition system? Name parts of an induction coil? How are valves timed? What is an electric motor starter and how does it work? What are advantages of worm drive gearing? Name all important types of ball and roller bearings? What is a "Three-quarter" floating axle? What is a two-speed axle? What is the Vulcan electric gear shift? Name the causes of lost power in automobiles? Describe all noises due to deranged mechanism and give causes? How can you adjust a carburetor by the color of the exhaust gases? What causes "popping" in the carburetor? What tools and supplies are needed to equip a car? How do you drive various makes of cars? What is a differential lock and where is it used? Name different systems of wire wheel construction, etc., etc.?

*A valuable work written with special reference to the requirements of the non-technical reader desiring easily understood, explanatory matter relating to all branches of automobiling. The illustrations are distinctive, instructive and valuable, and everything is made clear to the novice by careful selection of parts and designs showing the latest domestic and foreign practice.*

**A popular work at a popular price. Answers every question you may ask relating to the modern automobile.**

**MUNN & COMPANY, Inc., 233 Broadway, New York, N.Y.**

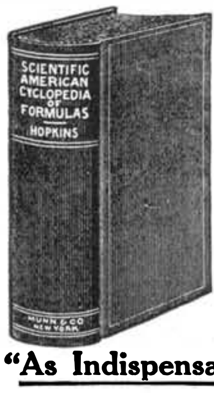
---

# The Scientific American Cyclopedia of Formulas

***The Most Complete and Authoritative Book of Receipts Published***

Partly Based on the Twenty-Eighth Edition of "The Scientific American Cyclopedia of Receipts, Notes and Queries"

*Edited by* **ALBERT A. HOPKINS,** Query Editor of the Scientific American




THIS is practically a ***new book*** and has called for the work of a corps of specialists for more than two years. Over 15,000 of the most useful formulas and processes, carefully selected from a collection of nearly 150,000, are contained in this most valuable volume, nearly every branch of the useful arts being represented. Never before has such a large collection of really valuable formulas, useful to everyone, been offered to the public. The formulas are classified and arranged into chapters containing related subjects, while a complete index, made by professional librarians, renders it easy to find any formula desired.

**"As Indispensable as a Dictionary and More Useful"**

***Following is a List of the Chapters:***

I. Accidents and Emergencies.
II. Agriculture.
III. Alloys and Amalgams.
IV. Art and Artists' Materials.
V. Beverages; Non-Alcoholic and Alcoholic.
VI. Cleansing, Bleaching, Renovating and Protecting.
VII. Cements, Glues, Pastes and Mucilages.
VIII. Coloring of Metals, Bronzing, etc.
IX. Dyeing.
X. Electrometallurgy and Coating of Metals.
XI. Glass.
XII. Heat Treatment of Metals.
XIII. Household Formulas.
XIV. Ice Cream and Confectionery.
XV. Insecticides, Extermination of Vermin
XVI. Lapidary Art, Bone, Ivory, etc.
XVII. Leather.
XVIII. Lubricants.
XIX. Paints, Varnishes, etc.
XX. Photography.
XXI. Preserving, Canning, Pickling, etc.
XXII. Rubber, Gutta-Percha and Celluloid
XXIII. Soaps and Candles.
XXIV. Soldering.
XXV. Toilet Preparations, including Perfumery.
XXVI. Waterproofing and Fireproofing.
XXVII. Writing Material,
Appendix: Miscellaneous Formulas; Chemical Manipulation; Weights and Measures; Index.

**SEND FOR DETAILED ILLUSTRATED PROSPECTUS**

***Octavo (6½x8¾ inches), 1,077 Pages, 200 Illustrations***
***Price, in Cloth, $5.00, Net. Half Morocco, $6.50, Net, Postpaid***

**MUNN & CO., *Inc. Publishers,* 233 Broadway, New York City**

---

# Instructive Electrical Books

*A selected list of books treating on electrical subjects, including electric wiring, induction coils, telephony, wireless telegraphy, etc.*

### *Design and Construction of Induction Coils*

By A. FREDERICK COLLINS. 6¼x9¼. Cloth. 272 pages, 159 illustrations. Price, $3.00.

¶ This work gives in minute details full practical directions for making eight different sizes of coils, varying from a small one giving one-half inch sparks to a large one giving twelve-inch sparks. The dimensions of each and every part are given, and the directions are written in language easily comprehended.

### *Complete Electrical Library*

By T. O'CONOR SLOANE, A.M., E.M., Ph.D. 5 volumes, 5¼x7¼. Cloth. Price, $5.00.

¶ An inexpensive library of practical and instructive books on electricity for the student, amateur, electrical engineer, the workshop, schools and colleges. The titles and prices of the volumes, when sold separately are as follows:

**Arithmetic of Electricity**
162 pages. $1.00.

**Electricity Simplified**
174 pages, 32 illustrations. $1.00.

**Electric Toy Making for Amateurs**
210 pages, 77 illustrations. $1.00.

**How to Become a Successful Electrician**
205 pages, illustrated. $1.00.

**Standard Electrical Dictionary**
682 pages, 393 illustrations. $3.00.

*Special Offer*—We will send, by mail or express prepaid to any address in the world, the above five volumes, handsomely bound in blue cloth with silver lettering, and enclosed in a neat folding box, at the special reduced price of $5.00 for the set.

### *Telephone Construction, Installation, Wiring, Operation and Maintenance*

By W. H. RADCLIFFE, E.E., and H. C. CUSHING, JR., E.E. 4½x6¾. Cloth. 223 pages, 132 illustrations. Price, $1.00.

¶ Describes up-to-date methods of telephone practice, including the principles of construction and operation of telephone instruments; approved methods of installing and wiring them; the means of protecting them from lighting and abnormal currents; their connection together for operation as series or bridging stations; and rules for their inspection, repair and maintenance.

### *Wireless Telegraphy and Telephony Simply Explained*

By ALFRED P. MORGAN. 5¼x7¼. Cloth. 154 pages, 156 illustrations. Price, $1.00.

¶ A popular, practical and simply worded treatise, embracing complete and detailed explanations of the theory and practice of modern radio apparatus and its present-day applications. It is written so that it can readily be understood by men who are not technical, and at the same time is sufficiently comprehensive and practical to be studied advantageously by the ambitious young engineer or experimenter.

### *Practical Electricity*

By T. O'CONOR SLOANE, A.M., E.M., Ph.D. 4¾x6¼. Flexible cloth. 761 pages, 556 illustrations. Price, $2.50.

¶ This manual, formerly known as Sloane's "Electricians' Handy Book," is a self-educating work on electricity and covers the entire field of practical electrical engineering. It is popularly written and may properly be termed an Elementary Text Book of Electricity. It presents the essentials of the science, with a sparing use of the simplest mathematics, and tells the practical working electrician just what he wants to know. It is a practical book for the practical man.

### *House Wiring*

By THOMAS W. POPPE. 4¼x6¼. Flexible cloth. 103 pages, 74 illustrations. Price, 50 cents.

¶ Describes and illustrates the actual installation of electric light wiring, the manner in which the work should be done and the best up-to-date methods of doing it. It gives just the information essential to the successful wiring of a building, without being too technical or overladen with details and contains nothing that conflicts with the rulings of the National Board of Fire Underwriters.

### *Electric Wiring, Diagrams and Switchboards*

By NEWTON HARRISON, E.E. 5¼x7½. Cloth. 272 pages, 105 illustrations. Price, $1.50.

¶ A practical work of ready reference for the wireman, foreman, contractor, electrician and all others interested in the application of electricity to illumination and power. It covers the subject of electric wiring in all its branches. Direct and alternating current wiring are both fully treated.

***We forward these books prepaid to any address upon receipt of the prices given. Our catalogue of scientific and technical books sent free on request. Write for one.***

**MUNN & CO., Inc., *Publishers*    233 Broadway, New York, N. Y.**

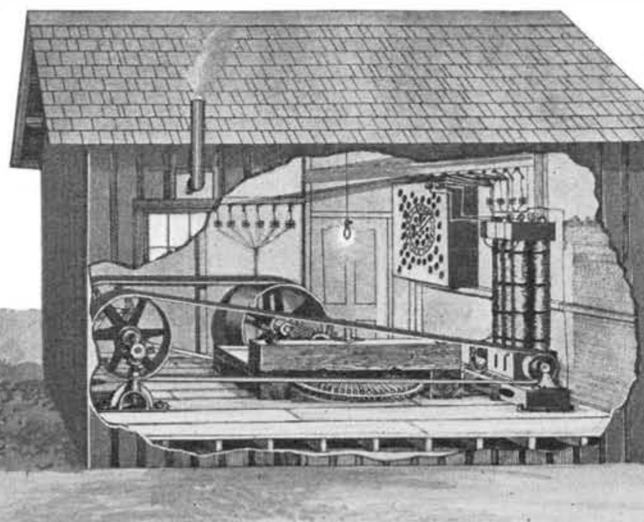
SEVENTY-FIRST YEAR

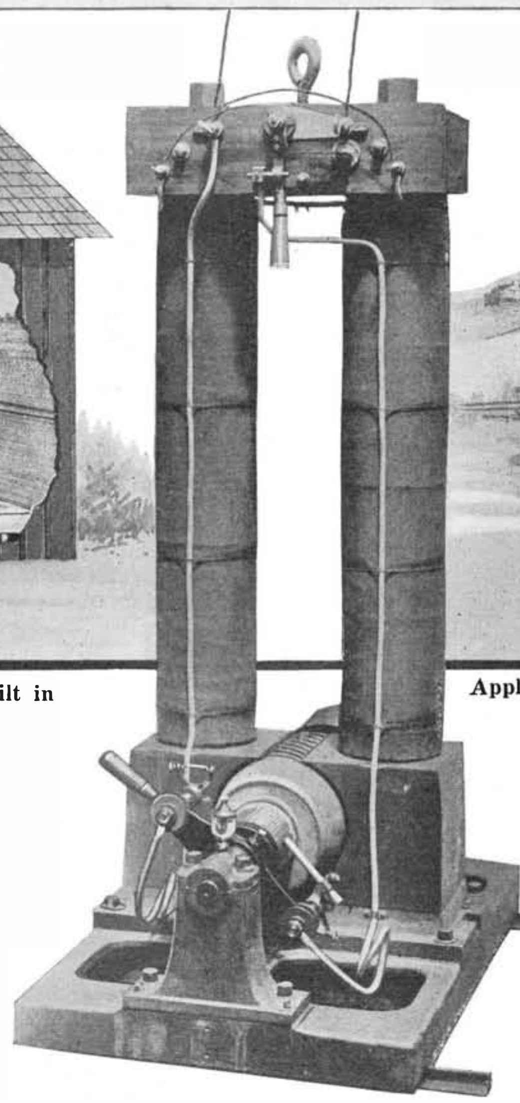
# SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

VOLUME CXII. NUMBER 22. | NEW YORK, MAY 29, 1915 | 10 CENTS A COPY $3.00 A YEAR

Interior of first Edison central station.





Edison dynamo of 1883.

The first Edison central station—1882.

This earliest central station in the United States was built in Appleton, Wis. It had a capacity of two hundred and fifty lamps.

## When Electricity Was Really in Its Infancy

By Prof. Francis B. Crocker

DR. WHEELER and I first turned our attention to electricity about 1874, which was forty years ago. Of course it was only the play of two boys who had the same bent, but we actually began to make crude forms of electric batteries, etc., at that time.

In the early days general knowledge of electricity was very limited. Few persons, in fact, not one in 10,000, knew anything about the subject. Even the books were largely confined to frictional or static electricity. For many years after that time there was a general notion that the dynamo acted by friction.

Quantitative ideas were particularly vague. For example there were no voltmeters or ammeters. During my career there have been three different kinds of ohms and volts with somewhat different values, that is, the B. A., Legal and International ohms. One inventor whose ideas were submitted to me claimed that his dynamo generated *better quality* of electricity which would produce more light, although it did not measure more; the same way that better quality of coal would produce more steam per pound burned under a boiler.

When we first began to study electricity, the telegraph was the only practical application. It was before the telephone was invented or any commercial forms of dynamo-electric generator or motor; arc or incandescent lamps; electric railway; power transmission or electro-chemical apparatus were used or even seriously considered. At that time the only important electrical plant in New York city was the main Western Union Telegraph Office on Broadway at Dey Street, in which one whole floor was filled with cells of gravity battery. The maximum output was about one eighth watt per cell, and there were, I think, 20,000 cells, which would give a total of 2½ kilowatts. Yet that was the largest electrical generating plant in commercial operation in America!

The telephone was first exhibited at the Philadelphia Exposition in 1876. The first ones that I ever saw were those we made ourselves from descriptions in the SCIENTIFIC AMERICAN. For a long time the telephone was regarded as merely an interesting toy. A friend of ours who owned the exclusive rights for New York city and vicinity sold them for $20,000, and thought he had done well.

The first arc lamps were those of Brush, Weston, and Thomson-Houston. I remember that one of the first practically used in New York was in the Equitable Building, where it was visited by thousands as a great curiosity. The "sub-division of the electric light" had been a great bugbear until Brush was able to run a number of arc lamps in series on the same circuit, without interference between them. Before that time each lamp had to have its own generator! How would the New York Edison Company like to operate on that plan to-day?

I remember very distinctly that I saw at Menlo Park the first successful incandescent lamp ever produced. There were only a few of them in Edison's laboratory. They could all have been easily put in a small basket. When they were brought out publicly they created a great sensation, and the gas stocks tumbled in price to the extent of millions of dollars throughout the country, and the Edison Company's stock went up to $2,500 per share; that is, twenty-five times the par value. They reached this enormous figure on the theory that the Edison stock had gained all that the gas stocks had lost! Edison "sub-divided" the electric light by putting his incandescent lamps in parallel. He devised the safety fuse, but at first it was single pole, that is in one wire only. At that time the sockets, switches, and fuse blocks had wooden bases which were so many pieces of kindling wood for starting fires. The so-called "underwriter's wire," then generally used, was miserably insulated and for that reason soon came to be known as "undertaker's wire."

For a long time the generators were all bi-polar even up to 100 kilowatts or more. With the exception of a very few so-called "Jumbo" Edison machines they were high speed and belted.

Long after electric lighting started there were practically no motors. Central stations objected to having them on their circuits for fear of affecting the lights. It took years to overcome this prejudice. To-day the motor load is considered much more desirable than the lighting load because it lasts longer and is more nearly constant. Motors began to be used commercially just about the time the Crocker-Wheeler Company was started in 1888, which was about ten years after electric lighting was introduced. At first it was hard to convince people of their value. People would ask, "Why turn the mechanical power of steam, gas or water into electricity and then back again into mechanical power?" That simple question seemed almost unanswerable. When each new application of electricity came out, and for applications in general, the public has always taken the wrong view or applied the wrong test. The new way was expected to be *cheaper* immediately, and nearly every one thought that the whole story. In point of fact electric lighting from central stations cost more than gas light up to the advent of tungsten lamps, certainly more than from kerosene oil. Convenience, cleanliness and many such advantages are really the reasons why it was preferred. The same is true of electric motors. Each new application of electric drive had to overcome the same old opposition. Apparently there was no great advantage in cheapness, and few could see the other fifteen merits which are really more important. Even if it was successful for other service each man thought that it was not good enough for the peculiar conditions of his particular work. This was notably true of carpet and silk looms. It was awfully hard to get people to try the first motor, but in a year or two you could not take away their electric drive for love nor money. The first induction motors were described in Tesla's paper at the A. I. E. E. meeting in May, 1888. I remember distinctly seeing there the only induction motors in the world—two small specimens lying on the table. Tesla did not invent the polyphase system or generator, or even the rotary field. Deprez in 1883 laid down the theory. Charles S. Bradley applied for a patent in May, 1887, a year ahead of Tesla. This patent covered too a rotary converter and the double-current machine, that is, it may be employed as a double-current, single or polyphase generator or motor.

The electric railway also came in about that time, that is, 1888 and 1889. At first there was much trouble with burning out of motor armatures. I remember that in one case a man in charge of repairing them was asked if they did not often burn out. He answered "Oh, no, only three to-day," and it was then about noon! In all the earlier forms of electric motors, even those used for traction, the working parts, coils and connections were much exposed, with little or no protection. The partly and wholly inclosed types of machine were not generally adopted until ten or fifteen years after motors had been in commercial use.

I was present when the first important power transmission system in the country was started. The power was generated at Niagara Falls and transmitted to Buffalo, the line being less than twenty miles long, but it was considered long distance transmission. The pressure used at first was 11,000 volts, which later was raised to 22,000 volts. The former voltage ranked as the highest in the world at that time in commercial service, and was regarded as so extraordinary that all sorts of precautions and special arrangements were required to handle it. It seemed to involve as many problems then as the 110,000 volts of to-day.

# SCIENTIFIC AMERICAN

**Founded 1845**

**NEW YORK, SATURDAY, MAY 29, 1915**

Published by Munn & Co., Incorporated. Charles Allen Munn, President; Frederick Converse Beach, Secretary; Orson D. Munn, Treasurer; all at 233 Broadway, New York.

Entered at the Post Office of New York, N. Y., as Second Class Matter
Entered as Second Class Matter at the Post Office Department, Canada.
Trade Mark Registered in the United States Patent Office



**Subscription Rates**

| | |
|---|---|
| Subscription one year | $3.00 |
| Postage prepaid in United States and possessions, Mexico, Cuba, and Panama. | |
| Subscriptions for Foreign Countries, one year, postage prepaid, | 4.50 |
| Subscriptions for Canada, one year, postage prepaid | 3.75 |

**The Scientific American Publications**

| | | |
|---|---|---|
| Scientific American (established 1845) | per year | $3.00 |
| Scientific American Supplement (established 1876) | " " | 5.00 |
| American Homes and Gardens | " " | 3.00 |

The combined subscription rates and rates to foreign countries including Canada, will be furnished upon application.

Remit by postal or express money order, bank draft or check.

**Munn & Co., Inc., 233 Broadway, New York**

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp* the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

*The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.*


## What Sank the "Lusitania"?

IN its endeavor to becloud the issue, official Germany has claimed that the ammunition carried by the "Lusitania" contributed largely to the swift sinking of that great ship.

Now this is a technical question, and to anyone who is technically qualified to judge the matter, the explanation offered is, on the face of it, absurd.

This war has proved over and over again that one submarine torpedo of the German type, carrying 420 pounds of high explosive, is sufficient to sink a warship —even a battleship which, exclusive of the double bottom deck, is divided into no less than two hundred and fifty separate watertight compartments, big and small.

The question of the length of time a ship fully subdivided will remain afloat after being torpedoed, depends largely upon where the blow gets home. In the case of a battleship, especially a thoroughly modern ship like the "Audacious," the blow of a mine or a torpedo, in addition to the local damage, may so badly shake up and loosen her internal structure, that gradual seepage of water will occur through the bulkheads, and she will eventually sink several hours after the attack. But should the blow strike in the region of a magazine, as in the case of the Russian "Petropavlovsk" and the Japanese "Hatsuse," the explosion of the torpedo warhead may instantly be succeeded by the far greater explosion of the whole magazine, and the ship, no matter what her size, will go down in two or three minutes' time.

Now the fact that the "Lusitania" remained afloat eighteen or twenty minutes after being torpedoed completely disproves the assertion of the Germans that her cargo of ammunition exploded—and nobody knows this so perfectly well as Admiral von Tirpitz himself and the subordinate in command of the submarine which sank the ship.

To be convinced of this, let us consider the case of two warships in which the ammunition exploded, and see what happened. In the case of the U. S. S. "Maine," when the flame and shock of the mine which contributed to her swift sinking reached the forward magazines, they exploded and the enormous force of the gases lifted her forward deck and rolled it back upon the after part of the ship just as one would turn the leaf of a book. Again, take the case of the French battleship "Liberté," whose forward magazine exploded through deterioration of her smokeless powder. Exactly the same thing happened as in the case of the "Maine," but on a larger and more destructive scale. The decks of this great ship lying above her magazine were torn loose from the hull, lifted high in air and rolled back, upside down, upon the after part of the ship.

If the cargo of ammunition carried by the "Lusitania" had been set off by the torpedo which struck her, similar results would have followed. The enormous expansive force of the gases of the explosion would have blown out the sides of the ship above the waterline and torn open her decks above, folding them back upon themselves. Did any such destruction occur? Was there any evidence whatsoever of such an explosion? The very fact that the ship remained afloat as long as she did proves that nothing of the kind happened, and that the ammunition in her hold had no part in the sinking of the ship.

So enormous is the charge of explosive carried by the submarine torpedo of the Germans that the single torpedo which struck her not only tore a vast opening in the outer skin of the ship, but the disruptive effects of the gases let loose under high pressure within her hull structure were sufficient to wreck the inner wall of the side bunkers and produce an immediate and enormous inrush of water, besides loosening up the frames and bulkheading in the neighborhood of the explosion to such an extent that less than half an hour was sufficient to put the great ship below the surface.

A battleship not only carries a heavy watertight protective deck, but the underwater portion of the ship below this deck is divided and subdivided transversely and longitudinally until she contains, as we have said, over two hundred and fifty separate watertight compartments, big and little.

The "Lusitania" contained below the waterline only thirty-four such compartments—and this was all that could be conveniently accommodated within a ship whose primary purpose was for the uses of commerce and not to face the perils of modern submarine warfare. Since she was designed the explosive charge in the warheads of torpedoes, at least of those used on submarines, has been more than doubled. The commander of the German submarine, when he discharged his torpedo at point-blank range and saw it strike home, knew that the "Lusitania" would probably go down fast and long before her helpless passengers could take to the boats. This was expected and so intended by the Imperial German Admiralty.

## The War and the Scholars

BUT for the fact that philosophers have so often, in the past, proved to be anything but philosophic when put to the test, we should view with much astonishment the efforts made by the savants of a certain belligerent country of Europe to disparage the intellectual achievements of their erstwhile friends and colleagues among the enemy.

German scholars had so long been in the habit of taking their own intellectual superiority for granted that there was little left for them to say on the subject when the war broke out. French scholarship was somewhat tinged with chauvinism before the war, and the French temperament serves to explain many things. The scholars of England, however, who had for some time been living under the spell of the supposed preeminence of things German, suddenly executed so complete a *volte-face* as to suggest, first, that the English are a more volatile race than we had supposed them to be, and, second, that if these same scholars are now sincere, they must have been amazingly deficient in good judgment prior to the first of last August.

We hasten to say that this criticism does not apply to all English scholars, though it does apply to some who are very highly placed in the learned world. The purpose of the present article is, indeed, to contrast the attitudes of two classes of Englishmen, viz., those who have completely lost their heads in their eagerness to dispraise the enemy, and those who have not permitted their patriotism to get the better of their good sense.

It may be admitted that German scholarship had become a somewhat extravagant cult in England before the war, and that a return to normal-mindedness in this respect was altogether desirable. Normal-mindedness is not, however, evinced in the following onslaught which Prof. Sayce of Oxford recently delivered in the *Times:*

"It is astonishing that British scholars and politicians should still be found speaking of 'our intellectual debt to Germany.' It is worth while, therefore, examining in the dry light of reason what Germany has really done for culture and scientific progress.

"As to music, I can say nothing, for I am not a musician. In literature Germany has Goethe, who occupies the first rank. Heine was a Jew, who regarded the Germans as barbarians. Schiller, the most characteristically German of German writers, was a milk-and-water Longfellow. In philosophy there are Kant and Hegel, but Kant was more than half Scottish in origin, and it is difficult to say what the Hegelian philosophy would have been had the German language been more cultivated. In science none of the great names is German. We look in vain for any that can be put by the side of those of Newton, Darwin, Faraday, Laplace, or Pasteur. In my own departments of study it is the same tale. . . . On the artistic side perhaps the less said the better. German taste in architecture and dress is proverbial."

Is it necessary to comment on this extraordinary diatribe? We regret that Prof. Sayce is not a musician, for his authoritative opinion of German music would undoubtedly have been interesting. As to the rest, let us frankly admit that German culture has been overrated in some quarters. Does it not remain true that the whole world owes an "intellectual debt to Germany," and a heavy one?

It is pleasant to turn to a more temperate estimate of German achievements, from the pen of a British man of science who has always been imbued with the spirit of world-wide solidarity in intellectual matters. Dr. Hugh Robert Mill, director of the British Rainfall Organization, writes in *Symons's Meteorological Magazine:*

"At this time, when it is as fashionable to ridicule and decry all things German as it was to ridicule and decry all things pertaining to other nations a century or sixty years ago, we feel it to be a matter of scientific duty to acknowledge our equal indebtedness in the past fifty years to all these nations. Whatever may be the opinion of some men of science as to the inferiority of Germans in their particular studies, we and our readers cannot fail to remember how much we owe to German and Austrian meteorologists. While we yield to no one in our detestation of the war which Germany and Austria-Hungary have forced upon the world, or in our determination to do all that is possible to defeat the aggressions and ambitions of those governments, we cannot be so false to our own consistency as to stigmatize as poor or contemptible those vast and noble acquisitions to knowledge made in the last half century by those Germans, whom, up to last summer, all our learned societies delighted to honor. Although for the present we carry on our work without the aid of the subjects of enemy-empires, we trust that our pages in years to come will once again rejoice in the brotherhood of the men of science of a re-made Europe and a world at peace."

## "Inventions Wanted"

"INVENTIONS wanted." You see it often at the head of articles in newspapers, calling the attention of inventors to needed improvements. It also appears in the literature sent out by patent fakers and by some agents who are not fakers. Probably every inventor has scanned such lists in the hope that he might find there some idea of real value. Ideas there are in plenty, but they resemble the bunches of "outlaw" horses which some unscrupulous dealers a few years ago were wont to gather on the prairies and ship east to be sold to unsuspecting farmers. These collections of "long-felt wants" represent what is left over after all the tractable, easy-to-handle ideas have been caught, harnessed, and put to work.

In the majority of cases as much invention is displayed in discovering the need of a new device or machine as in perfecting the mechanism by which the need is supplied.

Take, for example, half a dozen American inventions in common use—the telegraph, telephone, typewriter, phonograph, sewing machine, and harvester. From the point of view of the inventor of mechanisms, the sewing machine and the self binder are perhaps as ingenious as any of them. What is remarkable about them as a group is not mechanical ingenuity; it is the prophetic foresight of the inventors who saw, imperfectly, no doubt, but clearly enough to be inspired thereby, a vision of a world transformed. They saw the housewife relieved of endless drudgery; the farmer's capacity for production multiplied; the slaves of the pen set free.

But the chief difficulties they surmounted were not mechanical. They arose from the lack of proper means of perfecting their inventions and from the apathy and indifference of those whom the inventions were intended to benefit. Many a student has set before him more intricate problems than were there in their primary form. But a student knows his task is possible; the inventor believes his is also, but often he cannot get anyone else to think so. The ingenuity displayed in perfecting these devices is less wonderful than the fact that the world was so long content to plod along without them.

People did not know that they wanted these things. Some, who had little else to do, vaguely dreamt of them, perhaps, but the world at large was quite satisfied. Mankind wants everything in sight, but what is not in sight it assumes to be impossible of attainment.

But the inventor knew that his devices were needed and in his mind's eye he saw the operation of the particular law or coincidence of several laws by which his dream was to be realized. Therein lay his genius. Were there no such thing as a telephone in existence we could pick a hundred men perfectly competent to invent and perfect it, could we convince them of its possibility and importance. But most of us cannot pick the next man who is to pierce the future and banish some burden we now labor under because we can see no hope of relief and have no faith in such relief.

As a general rule, inventors will find that the problems set for them in "Inventions Wanted" are not usually the most promising avenues to success. Having resisted the efforts of other minds, such problems are often destined to remain unsolved until the discovery of a wholly new principle or some often apparently unrelated fact opens the way to a solution.

The inventor's best chance lies in filling unfelt needs, not in wrestling with "long-felt wants."

## Science

**Wrapped and Unwrapped Bread.**—A considerable amount of recent literature has been devoted to the subject of wrapping bread. An elaborate chemical and bacteriological investigation of the subject was reported some time ago by Jacobs, Leclerc and Mason in the *American Journal of Public Health.* These investigators sought to determine the kind of paper most suitable for wrapping, the length of time after baking that bread should be wrapped, and the bacteriological condition and weight of both wrapped and unwrapped bread. For breads whose crusts are to be kept dry and firm, such as Vienna and French breads, porous paper is better than waxed paper. Bread reaches the temperature of the room about three hours after baking, and this is the best time to wrap it. Further delay entails the danger of contamination with bacteria and molds. If wrapped too soon—say, one hour after baking—it retains sufficient heat and moisture to favor the growth of organisms, especially when waxed paper is used. The crust of the loaf as it leaves the oven is practically sterile. The same writers examined a large number of samples of both wrapped and unwrapped bread bought in retail stores. Of the unwrapped loaves 62 per cent showed organisms of the *B. coli* type, as compared with only 7 per cent of the wrapped loaves. Another contribution to this subject is an article by Barnard and Bishop in the *American Food Journal,* dealing with the effect of wrapping upon the chemical composition of the loaf. It was found that wrapping in either semi-porous waxed or paraffin paper prevents the escape of moisture and tends to preserve the colloidal condition and physico-chemical equilibrium, the destruction of which produces staleness. The effects of wrapping vary considerably for different kinds of bread.

**A Guide to Our Edible Fungi.**—As everybody knows, a deplorable amount of good food goes to waste because the public is familiar with but few of the many edible species of fungi. It is true that the nutritive value of fungi has been much exaggerated; they are by no means comparable in dietary value to meat, as is often claimed; but on the other hand, they are more nutritious and, when properly cooked, decidedly more palatable than many things that enter into the everyday menu. A desultory propaganda in behalf of mycophagy has been carried on for years, both in this country and abroad. The latest contribution to this campaign is Bulletin No. 175, just issued by the Department of Agriculture, entitled "Mushrooms and Other Common Fungi." In this useful manual, the authors, Flora W. Patterson and Vera K. Charles, tell us, among other things, of the efforts which certain European governments have made to teach their citizens the food value of mushrooms. All over France exhibits of the more desirable species are held; while at Rouen during the season there are daily lectures on this subject illustrated by fresh specimens. In Saxony systematic instruction concerning mushrooms is given in the public schools. The French have taken to canning many wild mushrooms, in addition to the familiar *Agaricus campestris* grown in mushroom cellars, and these are now exported to the United States, which also receives tons of dried wild mushrooms from China. The new bulletin contains descriptions, in language as non-technical as the circumstances admit, of more than 150 species of fungi, together with splendid photographs of at least half of the species described. The poisonous species are carefully pointed out, and several recipes for cooking the other kinds are appended. There is a simple key to the genera and a glossary.

**The Chemistry of the Pacific Kelps.**—We have recently noted the appearance of a bulletin of the Department of Agriculture giving full statistics as to the extent of the giant kelp beds on the Pacific coast, and suggestions regarding their exploitation. A further important contribution to this subject is an article by Guy R. Stewart, of the California Agricultural Experiment Station, on the "Availability of the Nitrogen in Pacific Coast Kelps," published in the *Journal of Agricultural Research.* As a result of extensive experiments the author finds that in using dried and ground kelp as a fertilizer the readiness with which the nitrogen in it is changed to ammonia and nitrates in fresh field soil varies with different species and with the mode of preparation. The nitrogen of *Nereocystis luetkeana* is relatively very available, but this species is of minor commercial importance. The principal commercial species, *Macrocystis pyrifera,* is very slowly changed in the soil, the availability of its nitrogen being greatest when the kelp is added in a fresh or only partly dried condition. *Macrocystis* must, however, be dried till crisp in order to grind readily. This drying should not be continued longer than necessary, and the kelp should not be scorched or overheated. In the same *Journal* another California chemist, D. R. Hoagland, gives a detailed account of the "Organic Constituents of Pacific Coast Kelps." In connection therewith he deals with certain interesting economic phases of the kelp question; viz., the possible feeding value of kelps for man or animals, the utilization of its organic by-products, and the destructive distillation of kelp for commercial purposes. In all three directions the possibilities appear to be very slight.

## Astronomy

**The Spectrum of Mellish's Comet** was observed at Lowell Observatory with the slit spectrograph on April 20th, and according to a telegram from Director Lowell, published in *Popular Astronomy,* was found to consist of the usual series of cometary bright bands, but with a relatively intense background of continuous, i. e., solar, spectrum of the emission bands. The group of bands about wave-length 4040 was brighter and those of hydrocarbons fainter than in most comets. A photograph of the comet on the same morning showed a tail of two divergent branches, 1½ and ¾ degrees long, respectively.

**The Time Service at Antwerp,** or Bureau de l'Heure, located at the Pilotage, continued its work up to the date of the German bombardment, last October. This office normally gets its time by telephone from the Royal Observatory at Uccle, but after the latter institution was seized by the Germans on August 20th communication with it was cut off. Thereafter the service was maintained without astronomical observations, as the Riefler clock at the Antwerp office was known to have a very regular rate, and it was checked with the aid of a number of good chronometers. The small observatory of the Antwerp Astronomical Society is reported to have suffered no harm in the bombardment.

**The Astronomical Society of Pomona College,** at Claremont, California, consists of students of astronomy and members of the faculty of the college, together with resident college graduates engaged in astronomical work or study; there are also associate members, including alumni and others. Considering the local character of the society, its quarterly journal, known as the *Publication* of the Astronomical Society of Pomona College, now in its fourth volume, is a remarkable production. It is printed on the best paper, fully illustrated with photographs, charts, etc., and, last but not least, is replete with interesting astronomical literature. Besides original articles, each number contains signed abstracts of the most important current astronomical articles in other journals. The editor of the *Publication,* president of the society, and director of the college observatory is Prof. Frank P. Brackett.

**An Association of Amateur Telescope Builders.**—There has recently been organized in the Society for Practical Astronomy a Section for Construction of Astronomical Instruments, and efforts are being made to enroll therein as large a number as possible of amateur constructors of telescpoes and other astronomical apparatus in all parts of the world. Builders of home-made telescopes are very numerous. The new association offers them an opportunity of aiding one another with suggestions, besides which something in the nature of a correspondence course in telescope building is to be given by the director of the section, Prof. M. T. Fullan, of the Alabama Polytechnic Institute, Auburn, Ala. Persons who wish to become members should write to Prof. Fullan. Although the section is interested primarily in the making of telescopes, especially reflectors, it will also devote attention to such accessories as photographic cameras, spectroscopes, eyepieces, sidereal clocks, and other kindred apparatus.

**Suggestions for Observing Mars.**—Prof. W. H. Pickering's latest Report on Mars (No. 9) consists entirely of suggestions for the guidance of amateur and professional observers of the planet at its next opposition. No one who intends to make drawings of Mars can afford to ignore this report (given in full in *Popular Astronomy* for May). For studies of color a large aperture is desirable, but the definition of the surface markings is satisfactory, under good atmospheric conditions, with an aperture of 5 inches, while many canals were clearly seen by Prof. Pickering at the last opposition in his 3-inch finder with a magnification of 180. For comparison of the "seeing" at different stations or on different nights a standard scale is recommended, defined by the appearance of the image or disc of a bright star and the diffraction rings. Perfect seeing is designated 10 in a 5-inch refractor, 11 in a 7-inch, 12 in a 10-inch, and 13 in a 14-inch. It is of little use to observe Mars when the seeing is below 6 or the altitude is below 30 degrees. The writer uses water colors for the groundwork of the disk, the yellow ochre, orange and reds, but for the greens, blues and browns he finds colored pencils, in connection with lead pencils of various degrees of hardness, more satisfactory. In order to apply the correct tints it is very important that the source of light illuminating the paper should be of the same color as the sun seen from a distant body. Prof. Pickering used small tungsten lamps at the last opposition, and at the next proposes to have the light of the same lamps transmitted through pale blue glass, thus giving the paper an illumination of very nearly the same color as the illumination of the surface of Mars by the sun. It is especially desired to secure as many drawings as possible of the planet in certain standard aspects; viz., when the Martian longitudes 0, 60, 120, 180, 240, and 300 are central at the point of observation. This plan was followed by a few observers at the last opposition, and comparisons of the drawings have given very interesting results.

## Notes for Inventors

**Woman Patentee Abroad.**—It is believed that Sybilla Masters was the first American woman to secure a foreign patent, she having, through Thomas Masters, secured a British patent No. 401, dated November 25th, 1715, for a Process for Treating Corn.

**Lighting the Key-hole.**—August Sundh of Hastings-Upon-Hudson, New York, has patented, No. 1,136,378, an illuminated door knob having an electric lamp which may be lighted by a suitable button to give light to a key-hole or to the dial of a safe.

**Deck Seats Convertible to Life Boat.**—David Davies of North Carlton, Victoria, Australia, has obtained patent No. 1,134,672 in which are shown two longitudinal half sections adapted to be used separately as deck seats on a ship and to be united and secured together to form a life boat.

**A Golfer's Exerciser.**—A patent, No. 1,137,349, has been issued to Frances E. Patterson of Wilmington, Del., for an apparatus in which a golf grip or handle is connected at one end to a flexible cord which is wound on a spring spool and operates with tension on the grip in the successive movements representing the swing of a golf club.

**Apparatus for Cooling and Agitating the Air.**—Herman E. Baumgartner of Osage, Iowa, has patented, No. 1,133,255, an apparatus in which a pan supports a block of ice alongside of which is formed a housing for an electric fan, the infeed of which opens toward the block of ice so that the air is sucked over the block of ice and the cool air is forced into circulation.

**Influencing Unemerged Teeth.**—Patent No. 1,137,298 to W. E. Walker of New Orleans, La., is for a device for influencing the alveolar process seeking to develop artificially a pressure simulating lip pressure and thereby exert an influence through the gums upon unemerged but wrongfully disposed teeth, or counteract the influence of the tongue in a patient predisposed to press the same against the gums as frequently occurs in mouth breathing.

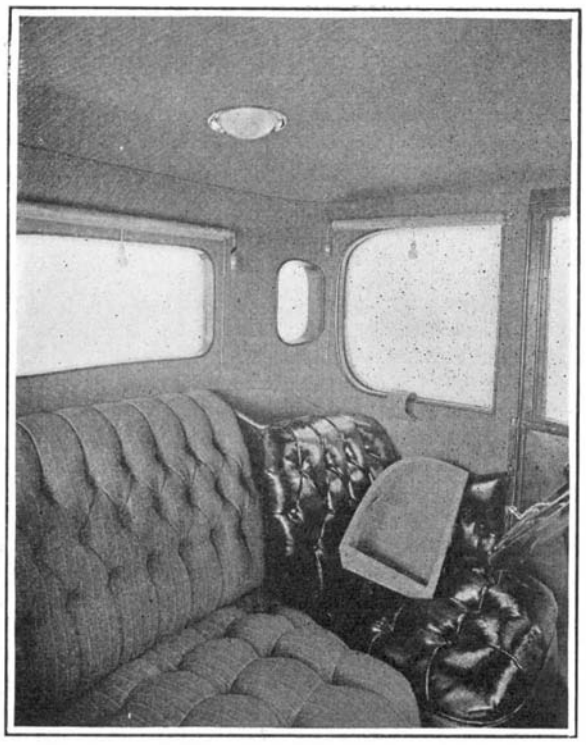
**Adjustable Golf Stick.**—D. & K. Roberts of Grantham, England, in patent No. 1,135,621 present a golf club the head of which is formed to permit the convenient interchangeability of heads or striking faces, each of the head pieces having two faces either of which may be adjusted into playing position and the several different forms of head being interchangeably applied to the head of the club so that each loose head is the equivalent of two ordinary clubs and by carrying a number of loose heads the necessity of carrying numerous clubs will be avoided.

**Oscillation-receiving Devices for Wireless.**—Four patents, Nos. 1,136,044 to 1,136,047, inclusive, have been issued to the Wireless Specialty Company of Boston as assignee of Greenleaf Whittier Pickard of Amesbury, Mass. In the first patent the receiving device has a member containing silicon with a contacting member containing metal antimony; in the second patent the contacting member contains arsenic and antimony; in the third patent the contacting member contains metal bismuth and in the fourth patent the contacting member contains metal arsenic.

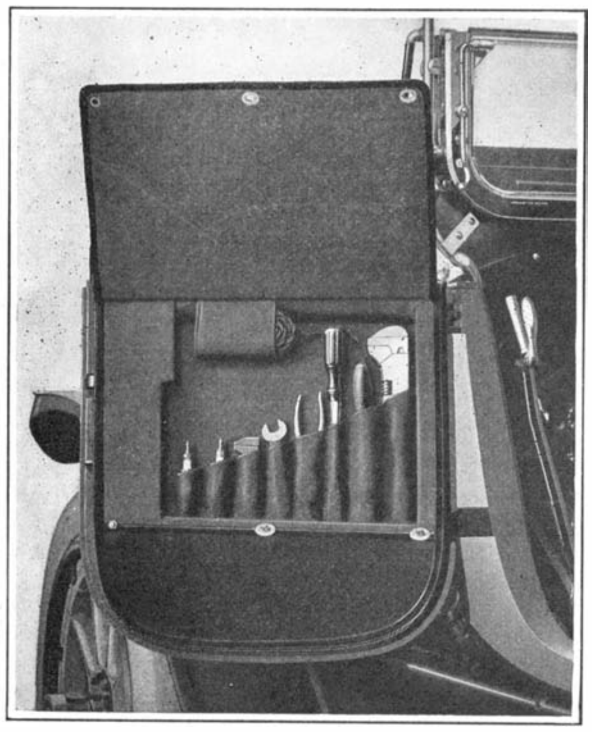
**A Golf Patent for Keeping the Eye on the Ball.**—C. T. Ramsay of Liverpool, England, patent No. 1,135,921, shows an optical instrument which can be worn over the eyes like a spectacle and by which the sight of the player is concentrated on the ball, the opaque "blinkers" having a relatively small aperture through which, and through which alone, the wearer can see and thus the distance in front and behind the ball is so small that he must see it definitely and he is thus compelled to keep his eye on the ball. The blinkers are adjustable so they can be set to suit the eyes of different persons.

**Novel Hat Brush.**—A hat brush which is carried within the hat itself is a recent Paris novelty. It can be used with felt or silk hats. The brush is of small size and very light weight, and is provided with a clamp which allows of fixing it inside the hat, and in this position it is out of the way and does not add materially to the weight of the hat. Such a little device will prove most convenient either for ordinary times or in traveling. Two kinds of brush can be used according to the case, that is, a fine brush for felt hats or a plush makeup for use with silk hats. The brush in any case does not weigh more than half an ounce.

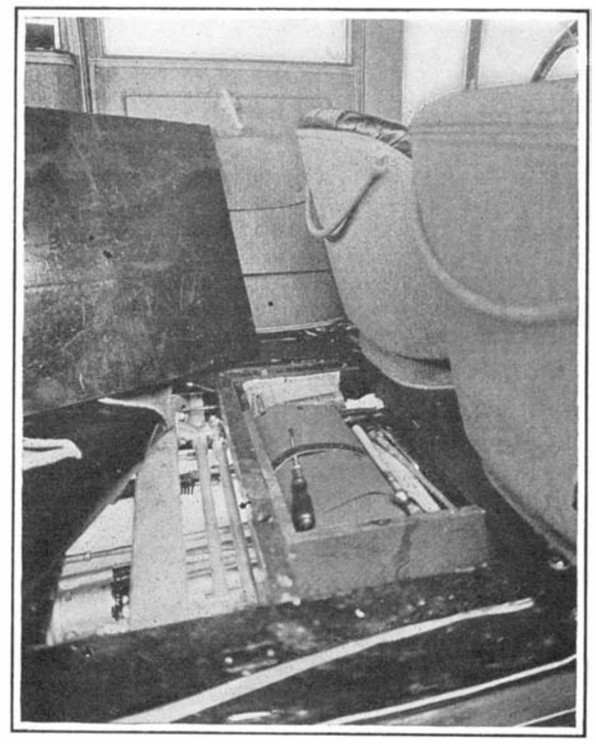
**War's Effects on Foreign Patents.**—It is sometimes asked by Americans whether patents can be obtained at the present time from the nations at war and it is somewhat remarkable how little difficulty is experienced in transacting business with the foreign Patent Office. Nevertheless, the number of applications filed abroad has been greatly reduced as illustrated, for instance, in the United Kingdom, reports giving the number of applications received in the British Patent Office in 1914 as smaller than in any other year of the last decade, the number of applications for 1914 being 24,820, while in 1913 it was 30,077. Design applications in 1914 were 34,354 and in 1913 were 40,429 and trade-mark applications in 1913 were 9,689 as against 8,317 in 1914.



Stowage compartments in closed cars generally are a problem; in this car, the basket slides down into a compartment behind one of the seats.



Most bodies are mere shells. This is an example of how a thinking designer has made use of what otherwise would be waste space.

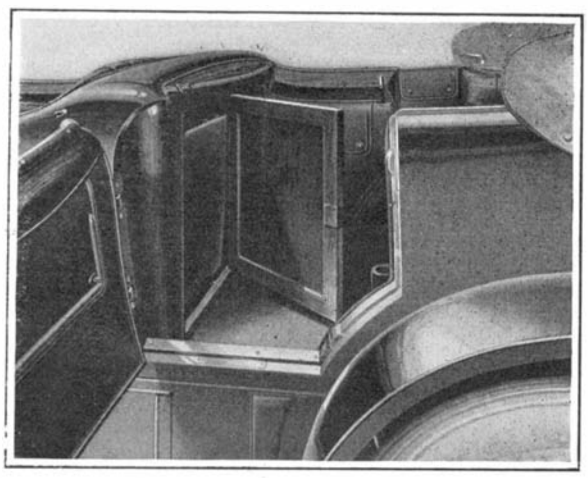


Here is an example of how a manufacturer has made use of space that otherwise would be wasted; a tool locker under the floor.

## Storing the Tourists' Needs

By Stanley Petman

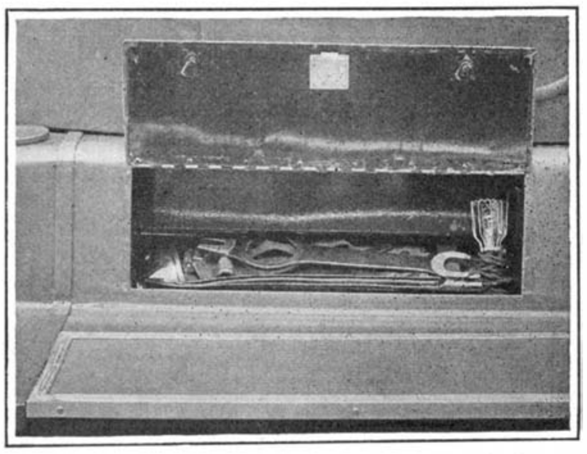
WHEN the first automobile tourist filled his tanks, cranked up and started on a journey fraught with more or less excitement, he experienced no particular problem in disposing of the equipment, the edibles and what-nots that then and now are a penance and a pleasure. In the first place, he had not a great deal in the way of equipment, and in the second place, the appearance of his car on the road could create no more comment if loaded down with boxes, baskets, and carry-alls than if it had none of these homely conveniences. The early tourists made no bones about appearance.



Large compartments at the back of the front seats serve to house the auxiliary chairs when they are not in use.

One box, more or less, strapped to a running-board or to the back of the tonneau, made no difference to the peace of mind of the owner.

But automobiles and the persons they carry have changed somewhat since those early days. The modern creation, to find favor in the eyes of a purchaser, must be long and lean and sleek and smooth. In short, it must be a finished creation in the fullest sense of the word; make-shifts have no place in its makeup. There must be a place for everything, which it is the duty of

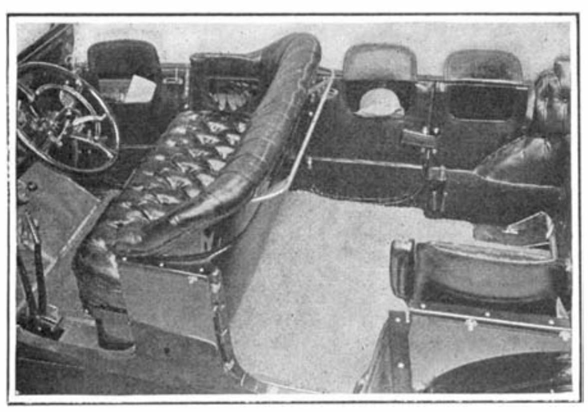


When tools are placed in this locker they are instantly available without the need for disturbing the passengers.

How waste space is utilized in a closed car. The compartment is large enough to house several bags in addition to spare tires, tools, etc.

the manufacturer to produce, and everything must be in its place, which is the duty of the owner.

It is a fact worthy of note and comment that though the modern car is carrying a great deal more equipment than did any of its illustrious predecessors and there is a great deal more room for the disposal of the things the tourist considers necessary, there is less in the appearance of the cars now to indicate this than ever



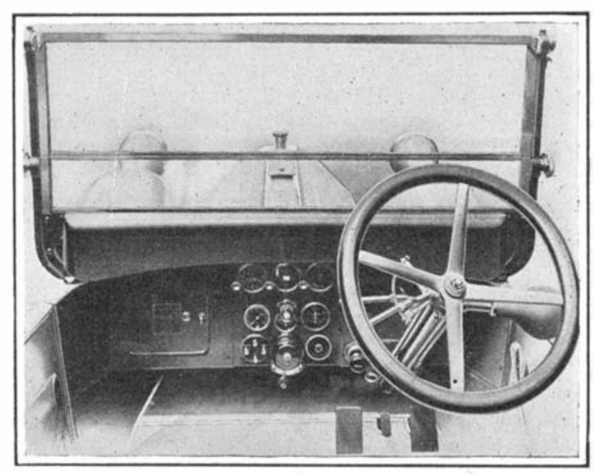
Route books, maps, touring data and other things that are wanted quickly fit nicely into these deep pockets.

before; and what is of greater importance, it seems likely that though the cars that are to come next year and the year after will provide carrying space for still more of what may be termed luxuries, there will be still less indication of their increase in capacity.

Now, the most natural question in the world is, Why? Why can the modern car be made such a carry-all without in the least destroying its lines? Why are there no bulbous protuberances? Where have the designers put all the things that once were in more or less plain view?

The answer to the first question is to be found solely in the skill of the designers. In a way they may be accused of taking a leaf or two from the books of their French cousins, for assuredly the French—and other European designers, be it added—are past masters in the art of providing almost extraordinary carrying capacity for freight other than passengers, and concealing it in the most ingenious manner.

Though the modern motorcar has proceeded along scientific lines and its development has come slowly in the light of past experience, it would seem that there is at least one feature of design that has not been given

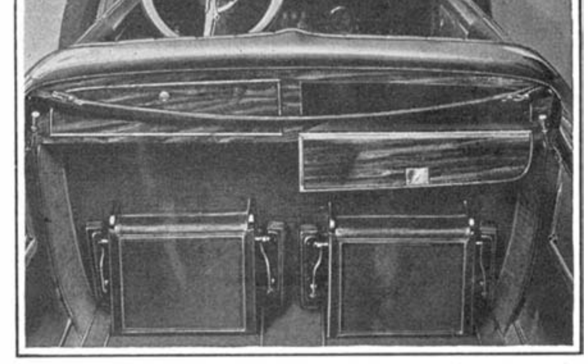


Small cupboards in the deep cowl serve as convenient receptacles for goggles, gloves and the like.

all the attention that it warrants; and, in the same breath, it would seem that this feature now is being given more attention than ever before.

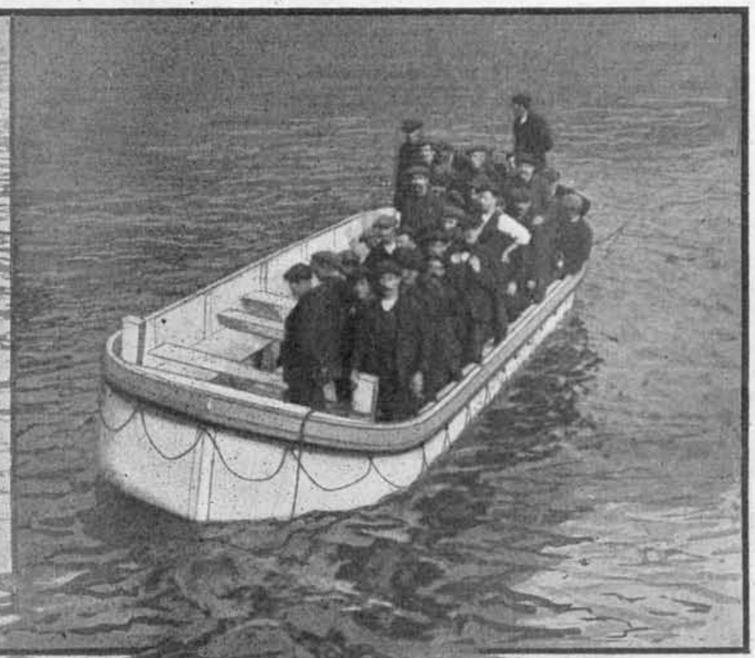
That feature is the careful utilization of waste space. To the average owner who knows not a great deal about the actual construction of his car, it may appear that there is not a great deal of room that has not been put to some useful purpose. But in the majority of cases this is not so. There are a dozen places where

(Concluded on page 502)



Here are some clever compartments that occupy the space between the foundation of the body and the outer shell.

Life-boat divided into two parts to demonstrate buoyancy.



Thirty-four men on one side of the boat to show stability.

## A New Life-boat

THE periodic recurrence of startling disasters at sea keeps the subject of efficient life-boats prominently before the public, and the apparent failure of the life-saving devices in many such cases, whether through deficiency in the apparatus, or in the utilizing and handling the same, frequently raises this most important question.

Efforts by inventors are, however, not lacking, and only a short time ago a new craft was tested out in England with apparent satisfaction. In principle it does not seem, from the information at hand, that there is very much that is new in it; but in the carrying out of the design unusually excellent results have been secured in buoyancy, stability and strength, for it can be raised or lowered with great weights without injury or distortion, and apparently can be safely launched overboard from a considerable height, as from the upper deck of a ship, in case of necessity and when davits were not available. In cases of this kind roller chocks, upon which the boat is adapted to rest, would make the operation possible. These same chocks can be arranged so that a boat can be easily moved forward or aft to a convenient position for lowering.

The foundation, so to speak, of this boat appears to be three lines of air tanks running longitudinally in its bottom, leaving two bilges between in which water coming aboard can collect without incommoding the passengers in ordinary cases. These tanks furnish sufficient buoyancy in a boat 28 feet long by 9 feet beam to support two hundred people, although such a number could not be practically accommodated in actual use. One of the illustrations shows thirty-four men grouped on one side of the boat, demonstrating its stability, while in another illustration the two portions of a boat that has been cut in two and loaded with passengers shows its buoyancy. Of course, the lines of air tanks are subdivided into many sections, some forty in number, so that if some are damaged so that they leak there is still ample floating power left. This quality makes these boats especially valuable in war service, for they can be punctured many times by bullets without becoming unseaworthy.

These boats are partially self-emptying, as pipes are provided that will carry off all water above the tops of the air tanks. This new style of life-boat, known as the Gerard, has been satisfactorily tested in England, and is soon to be put through a thorough series of trials in this country.

## The Study of Animal and Human Behavior

By Dr. L. K. Hirshberg

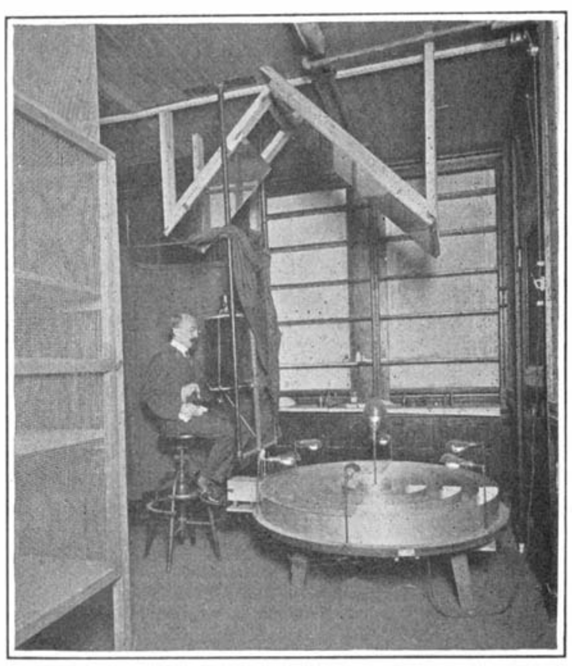
THE study of psychology has branched out into two new sciences of animal behavior and human behavior. Prof. John T. Watson is the leading exponent of the department of animal behavior, while Prof. R. M. Yerkes now tells the scientific world what human behavior is. This new science, he says, is only a portion of the general science of organic behavior. It presents practically the same problems as does animal behavior. To learn about the human "mind" you must perform the same sort of experiments as are conducted upon animals.

The behavior of mankind indicates the mind of the humans. There are really no ways in which you can discover a man's or an animal's mind except by what it does, what its habits are, or what it produces.

Not only the books, the periodicals, and the teachers of popular psychology, but a whole host of men who should know better, still teach that there are such things and activities as impulsive, habitual, instinctive, voluntary and reflex behavior. Says Dr. Yerkes: "This time-honored classification is no longer in favor."

Instincts are things to be observed and re-observed under varied and rigidly controlled conditions. What is true of instincts is also true of various senses and of habits.

It is rather late to define behavior, yet an attempt to do so may serve to correct certain impressions which seem not uncommon. The term, as used by the scientist to-day, is inclusive not merely of those gross and obvious activities exhibited by man in common with the other animals but of hidden organic processes. The behaviorist is interested quite as much in reflexes which might ordinarily be relegated to physiology, as in habitual or instinctive or voluntary acts. But he is interested, also, as much in the complex forms of behavior, known as conduct, as in the simpler expressions of human intelligence.

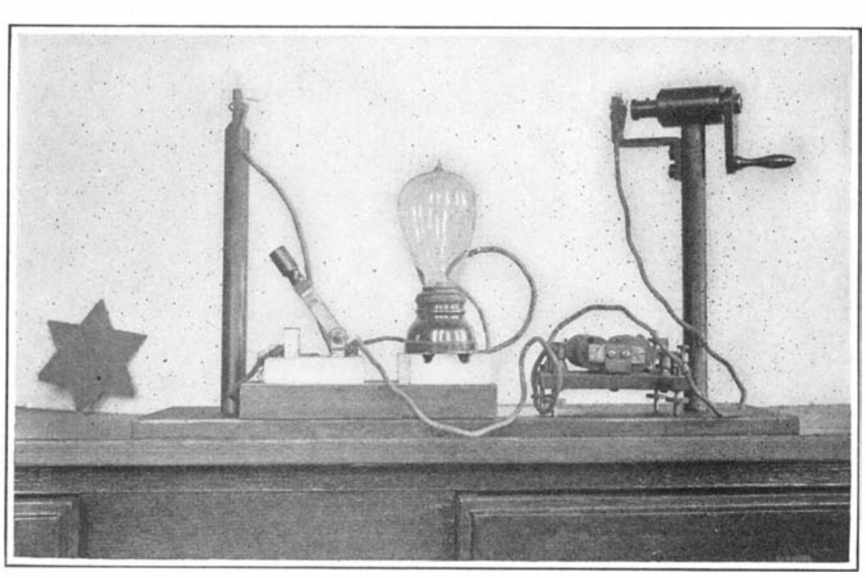


**Dr. Watson's maze for white rats.**

The ability of the animals to make their way out is an index of their mental capacity and behavior.

But the practical-minded person has doubtless been asking, "How may the reactions of a person be scientifically studied? Is it possible, ordinarily, to subject a human being to such conditions of observation as are used in experiments with other animals?" A few examples from studies of human and infra-human behavior will serve as an answer to these questions.

One of the most interesting aspects of organic activity is its modifiability. It is designated as habit-formation. Now, it happens that in a great variety of organisms the formation of habits has been studied experimentally. In the case of the dancing mouse, for example, the relation of rapidity of habit-formation to certain external conditions was investigated. An apparatus was so arranged that the mouse could choose as its route either a dark or light passageway; then was determined the number of experiences necessary in order that the animal should learn that, no matter what the spacial relations of the passageways, only the light one could be safely chosen as a way of egress, since each time the dark passageway was entered a disagreeable electric shock resulted. In this experiment, which was so conducted that strictly comparable results were obtained from several individuals, it was first ascertained that the less the difference in lightness of the two passageways, the longer it took the mouse to learn to choose correctly. Next, it was determined that the rapidity of learning varied with the strength of the electric shock, which was regularly given as punishment for mistakes. When the passageway differed markedly, the stronger the shock the more rapid the learning. When the passageways differed slightly, beyond a certain point, increase in the strength of the shock delayed the learning process. When the passageways differed by an intermediate amount, it appeared that an intermediate strength of stimulus was most favorable to habit-formation. From these observations it was possible to deduce the following law for the behavior of the dancing mouse. As the difficultness of visual discrimination increases, that strength of electric stimulus which is most favorable as a condition for the acquisition of a habit tends to approach a bare perceptibility.



**The shocking apparatus used to correct mistakes of animals in learning problems.**

The shock is at its maximum never enough to cause pain.

In this investigation there is, first, a definite problem; second, a reasonably large number of observational data; and third, a law of behavior, for the particular organism in question. In effect, what was done with the dancing mouse might be done with human subjects, should it seem desirable to gain definite knowledge of aspect of habit-formation.

Another illustration may be taken from the study of imitative activity. It is generally recognized that imitation may be studied experimentally in any organism. But up to the present most observations of this group of phenomena have been

casual, and opinions concerning the importance of imitation in any organism are quite likely to be based upon insufficient or inaccurate information.

In order to exhibit in the general features a method of studying imitation experimentally, investigations of this aspect of behavior in monkeys shall be considered. First of all, a number of acts or series of acts are sought which the animals either cannot learn to perform of their own initiative or learn with extreme difficulty. Such acts are most readily discovered in connection with artificially arranged situations as, for example, in connection with puzzle or problem boxes and similar experimental devices. The experimenter teaches one animal to perform an act, and thereafter, under definitely describable and constant conditions, he permits another animal to observe the behavior of the first. Any tendency for the second animal to imitate the first, or to modify its behavior in accordance with the activities of the first, is noted.

Such experimental studies as those of Watson and Hagerty have proved that certain monkeys imitate much less generally than is commonly supposed. And further, that they imitate seldom, if ever, in the purposive manner in which man imitates. It seems that, although they influence one another markedly in their behavior, this influence is chiefly a matter of the directing of attentions. The imitations of means in a voluntary and wholly conscious manner rarely appears among the mammals below man.

An illustration from actual experimental work which clearly indicates the need of analyzing behavior complexes and of dealing quantitatively with simple bits of behavior is furnished by some recent work which was done with rats. The object was to try to discover the modes of heredity of savageness and wildness in rats. In order to accomplish this task, it was necessary to analyze this savageness and wildness. This meant discovering those acts or organic processes which, taken together, mean to the observer savageness or wildness. The first result of observation was that biting, squealing, struggling to escape or attacking the experimenter and process of excretion appeared as important elements of savageness. The experimenter, relying upon these elements, measured roughly the savageness of a large number of individuals, arranging them according to their behavior in six grades, designated naught to five. On the basis of this obviously crude preliminary work certain facts indicative of the mode of transmission of savageness and wildness were ascertained.

In yet other observations on rats which involved the comparison of two group stock individuals and closely inbred individuals it appeared that the behavior of the two groups, in the face of certain experimentally arranged situations, differed greatly. This, upon careful observation, was attributed to differences of temperament. The stock rats were rather active, energetic, quick moving, whereas the inbred animals were more stolid, slow and deliberate. In order that the reactions of these individuals in various experimental situations be properly interpreted, it is essential that the experimenter obtain knowledge of their temperamental character, such, for example, as degrees of nervousness or of timidity, of savageness or wildness, quickness of response, persistence, energy, and so on through the list of aspects of behavior which, looked at as a whole, might be considered the temperament of the animal.

It is always safer to deal with items of behavior in a large or wholesale manner—safer, for example, to study capacity for a particular sort of musical expression, singing or violin playing, than to study musical ability in general.

Methods might be described of studying distance orientation, usual discrimination, other aspects of habit-formation, the permanency of habits, instinct and emotion in animals, but it will suffice for the present purposes to describe briefly two methods of analyzing behavior which have recently been devised. These methods, unlike those in general use by students of animal behavior, are applicable to man and to other mammals, even to birds as well. They were, indeed, planned with the idea that they should make possible the comparison of reaction-types or reactive tendencies in birds and mammals, and all these in turn with the tendencies displayed by human beings, either mature or immature, either normal or abnormal.

The two methods are the quadruple choice method and the multiple choice method. In the former the subject of the experiment is placed in a small room, on one side of which there are four doors. From experience, he learns that he may escape by one of the four doors, and only one, but which of the four to choose is his problem, for it is the plan of the experimenter to lock on a given trial the door through which the animal escaped in the previous trial and two others. This animal has absolutely no way of predicting which is unlocked. The general question is, then, how will a given type of organism or a given individual meet this situation? What habitual manner of meeting it will be acquired? How will the modes of reaction displayed by a child compare with those of a man?

The other method is similar in purpose to that of the first, but it offers somewhat more satisfactory opportunity to evaluate and compare results. It consists, essentially, in the presentation to the subject-bird or mammal, young or old, normal or abnormal, of a bunch of twelve keys numbered from left to right, one to twelve. The subject is given to understand, veritably or through actual experience with the apparatus, that pressing some one of the twelve keys will yield a certain desired result, such, for example, as the displaying of a picture, the presentation of food, the ringing of a bell. The experimenter sees to it that in no two successive tricks is the same key the one to be operated. He is, further, able to push back out of sight any number of keys, and thus present to the subject as few as one or as many as twelve.

Assuming that in a given experiment the observer decides that the key the fourth from the left shall always be the "right" one, it then becomes the task of the subject of the experiment to suit his reactions to the number chosen by the experimenter. Only if he discovers the guiding idea of the experimenter can he succeed, trial after trial, in touching the right key at first. This method may be varied almost indefinitely in difficultness, and it may be made to elicit numerous reactive tendencies.

It is obvious that both of the methods thus briefly described are attempts to elicit general reactive tendencies rather than to analyze reactions minutely and carefully. The methods are indeed intended to bring into clear light those modes of responding to a given situation which are characteristic of different types or conditions of living beings, and thus to furnish a basis for a profitable comparison of reactive tendencies.

The question is frequently asked: "Why is it that the behaviorist deals so often with the activities of the lower animals and so seldom with those of man?" There are two reasons: in the first place, most lower animals are easily obtained, kept in confinement, bred and reared for experimental purposes; in the second place, many of them, in comparison with human beings, can be readily controlled throughout their lives and subjected to experimental conditions. Because, then, of the availability and controllability of lower animals, it is far easier and more satisfactory to make the preliminary exploration and problems defining observations on their behavior rather than on that of a man. It is further to be considered that the time of the human subject is worth infinitely more than that of an infra-human subject. On the whole, it seems clear that investigators work to advantage in the early stages of science of behavior by letting the lower animals help to the formulation of the problems and the development of the methods. Once fairly oriented and reasonably skilled in technique, they may with better effect attack the problems in human behavior.

## What the National Guard Needs

**By Lieut. W. W. Wright, Company E, Second Infantry, N.G.C.**

The Army League of the United States, an association composed of many of the nation's leading men, is putting forth an earnest effort for an adequate and efficient military force. The Army League favors an adequate Regular Army, Organized Militia and Reserves as the best guarantee of peace.

President Wilson in his last message to Congress expressed his sentiments as being in favor of an adequate Regular Army backed up by an efficient National Guard and Reserve, rather than a large standing army. The efforts of the Army League are apparently along these lines.

The President's view is a logical one. He believes that the backbone of the nation's military forces should be composed of militiamen, trained men in every-day walks of life, who might be called on in case of need as were the "minute men" of the revolutionary period. The most reasonable and economical way to maintain an efficient military force for defense without the establishment of a large standing army, then, is through the National Guard.

Why do not young men join the National Guard in sufficient numbers to make it the efficient and powerful reserve that the nation desires, and what action is needed to make it appeal to the patriotism of our young men and induce them to enlist?

It cannot be denied that there is a shortage of suitable recruits for the National Guard and that the War Department finds considerable fault because many organizations of the various States are unable to recruit up to the minimum number required by the Government.

There are many reasons for this state of affairs.

In the first place, the National Guard is no longer to be looked upon as a social organization as it was in years past, when the chief duties required of it were to turn out in gaudy uniforms for dress parade or at social functions.

Since the passage of the Dick law several years ago the militia has been armed and equipped in exactly the same manner as the Regular Army, and it is now a plain business proposition, organized and destined to be conducted on a business basis as a part of the nation's first line of defense.

The same is expected of it as of the Regular Army, whose regulations it must adhere to, *only not so much of it.* While on duty its members must drill, work, and study the same as the regulars, *only not so much of it.*

Therefore, *why should not its members receive a certain per cent of Regular Army pay?*

From personal observations, made during more than ten years' service in the National Guard of three States, I believe that the sooner the "Pay Bill," which has been pending before Congress for the past three years or more, is passed, the sooner will the National Guard become the powerful and efficient backbone of our defense which the nation needs and desires it to be.

It has been said that you cannot buy patriotism. This is very true, *but how many men would join the Regular Army if they were not to receive some compensation for their services?*

*The one great fault with the National Guard, the seat of all the trouble and the cause of the greatest anxiety to nearly all company officers, is the lack of suitable recruits with which to fill up their companies.*

Give the average company commander in the National Guard enough good men, and provide a source of available recruits to draw from to fill up vacancies which constantly occur, and I dare say that he will turn out a company to be proud of and one which will compare favorably with a company of the Regular Army.

*How many captains of the Regular Army would remain in the service if they were required to go out and rope and hog-tie men and pull them into the service?* Yet this is practically what company officers in the National Guard are required to do to maintain their commands.

Each year recruits are becoming scarcer and scarcer, and the work demanded of both officers and men becomes more exacting. Each year the Government supplies us with more modern equipment, but what can we do with new guns and modern equipment, if we have not the men to use them? We are now furnished with practically everything required, except the most important of all, the recruits.

We now have sanitary corps and headquarter companies. Why not a recruiting service?

Company commanders in the Regular Army have drilled recruits assigned to them. Company commanders in the militia have to go out and hunt for theirs, and in many cases it becomes necessary to place raw recruits in the ranks in order to fill out their skeleton companies. When it is considered that one or two undrilled men can spoil the appearance of an entire company, is it any wonder that National Guard companies do not always appear to the best advantage? It does not signify that the average militiaman is not well drilled.

*What would the Army or Navy of the United States amount to if the Government did not have an efficient recruiting service to supply its enlisted personnel?* The United States spends vast sums of money annually to secure recruits for each branch of the service. The recruiting branch of the service is as necessary a part of the Army and Navy as are their fighting units.

*Therefore I advocate the establishment of a recruiting service for the National Guard.* Not to secure recruits in exactly the same manner as the Army and Navy do, but along somewhat similar lines.

I would suggest that the Regular Army bands be brought into play, and that they be detailed by the War Department in conjunction with able patriotic speakers and recruiting officers, to go to towns where a stimulus is needed to induce young men to enlist.

Patriotic concerts by army bands, which, as a rule, are not overburdened by their duties at the army posts, and speeches by able orators should tend to awaken the dormant patriotism in many young Americans and cause them to join the National Guard.

Suitable literature, both in circulars and billboard posters, setting forth the advantages and benefits to be derived from membership in the militia, should also be an aid in securing recruits.

One of the principal aims of the Army League is to combat the systematic anti-military propaganda of various organizations and of certain sections of the press, as occasionally shown in apparent efforts to prevent enlistment, and to encourage desertion and dissension in the existing *personnel.*

The general public, perhaps, is not aware that such anarchism and un-Americanism exists in this country, but it is true, nevertheless, that the propaganda of these various individuals and organizations has had the harmful effect of placing the National Guard in an unfavorable light in the eyes of some people, and it has unquestionably prevented many good men from enlisting therein.

The action of the Army League in this respect is a commendable one and should receive the support of all good Americans.

Sooner or later the Government may be obliged to

take drastic action in regard to this matter. It has taken years of unwarranted agitation and abuse to injure the National Guard in this manner. It will take considerable counter action to again place it in the esteem of all the people, where it rightly belongs.

Another point I wish to bring out is the promiscuous use of the uniform or parts of the uniform by persons unauthorized to wear such. One of the first things that officers are required to teach their men is to take pride in their uniforms.

What effect, then, does it have on the men of the Regular Army or the militia, when they see expressmen, cab drivers, members of lodge organizations, drum corps, etc., wearing the same uniform as they, or so near alike as to be undistinguishable to the eye of the ordinary layman? These men may be honorable enough in their respective callings so far as that is concerned, but surely they are not entitled to wear the uniform of the American soldier, and it is doubtful if such action would be tolerated in any other country. It does not tend to make the uniform respected either by the men of the service or the public in general, and no doubt this is one reason why men in uniform are not welcomed in many public places.

There is a law restricting the use of the uniform to the men of the service. It should be enforced to the letter.

These are some of the reasons why young men do not join the National Guard. These are some of the things that should be brought before the powers that be at Washington.

### Loading and Firing Submarine Torpedoes

SPEAKING broadly, the submarine is a gun and the torpedo is its projectile. Just as the field gun must be brought within range and trained upon the target, so must the submarine. The range of the submarine projectile varies according to the type which is used. The latest torpedoes, designed for long range firing, have a range of from seven to ten thousand yards. These are used on battleships, cruisers, destroyers, and other surface vessels. The submarine torpedo is of a special type, designed to deliver an unusually large charge of explosive at short range.

Experience had during the present war seems to show that it is extremely difficult to secure a hit against a fast-moving ship at a range of several thousand yards, and this in spite of the fact that the most recent torpedoes have a speed of 40 knots. This is explained by the fact that in order to secure a hit on a vessel which is moving athwart the course of the vessel which does the firing, it is necessary to aim the torpedo a considerable distance ahead of the moving ship, so that the torpedo and the ship shall reach the same point together. In order to secure accuracy, therefore, it is necessary to know the speed of the enemy and his distance with a very close approximation. It has been estimated that during the first battle in the fight off Heligoland there were over fifty high-speed ships engaged, all of which were using the torpedo freely. The battle, even if the intermission be omitted, lasted several hours; and yet not a single torpedo hit was recorded.

The successful torpedo work in the present war has been done almost entirely by submarines; and this, of course, is due to the fact that the submarine, because of its invisibility, is able at times to get so near to the course of a passing ship that it can fire its torpedoes at ranges of from say 500 to 1,000 yards, at which, if the officer in command of the submarine is at all capable, a hit should readily be made.

The submarine torpedo, that is to say, the torpedo used on submarines, because of its short range requires less air capacity and smaller engine power than the ordinary type, and the weight thus saved can be put into the charge of explosive, which, in the case of the latest German submarines, amounts to 420 pounds of extremely powerful trinitrotoluol. One successful hit by such a weapon will probably sink any ship afloat; for not only will an enormous rupture be made in the hull of the vessel at the point of contact, but the expansive energy of the gases within the hull will so strain and start the seams of the bulkheads in the vicinity of the explosion, that the ship, if she does not go down at once, will be filled by the gradual seepage of the water, and must ultimately founder.

Our front page engraving shows the front end of a typical submarine, which is provided with four torpedo tubes, grouped in the nose of the boat and parallel to its longitudinal axis. The tube, or gun, consists of a stout and strong bronze cylinder, into which the torpedo fits with a contact sufficiently close to prevent the escape past the torpedo of the charge of compressed air with which the torpedo is fired, and insure its being forcibly ejected from the tube. The torpedo, of which the latest submarines will carry from eight to twelve, is picked up by a chain hoist and swung in front of the breech on the tube, and then pushed home by the crew. The hinged door at the breech, answering to the breech-block of a gun, is then swung to, and locked by turning the hand-wheel shown in the engraving. Another hinged door at the muzzle of the tube outside the submarine is lifted, and a charge of compressed air introduced at the back of the torpedo serves to fire it. As the torpedo passes down the tube, a small lever projecting from the torpedo is tripped and thereby admits the compressed air which drives the turbine engine of the torpedo.

The tube being fixed firmly in the hull of the submarine, it is necessary to train the submarine itself directly on its object, or somewhat ahead of it, as the case may be. This is a difficult maneuver and calls for quick work with the rudder. Sighting is done by means of the periscope.

### The Current Supplement

THERE is a gratifying variety in the matter contained in the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT, No. 2056, for May 29th, 1915. Some excellent pictures and a short article describe a new railway that has been built through a particularly picturesque region of the Alps from the Rhône to the Rhine. In the solider line is a valuable article on the Development of Electromagnetism, which reviews some of the newer important problems. The Protection of the Strong discusses the results of the practical working of systems for protecting the poor and covers an interesting sociological question. Making Museums Useful will appeal to every reader interested in educational matters. The impression the public has heretofore had of museums appears to be that they are merely decorative public buildings, but this writer points out forcibly the great educational value of even a small museum, intelligently arranged and conducted, even where resources are limited and the outfit inconspicuous. The History of Opium gives a large amount of historical and technical information that is both interesting and useful. There is another of Sir J. J. Thomson's remarkable lectures on Atoms and Ions, which give the most complete exposition of the subject that has been published. The description of the European aeronautical laboratories is concluded, and there are a number of shorter articles of interest.

### Pavement Patent Sustained

BY a recent decision of the Supreme Court of Alberta the Canadian patent to Warren Brothers for the wearing surface of street pavement, known as the bitulithic pavement, was sustained. The case arose over a paving contract in the city of Calgary undertaken by the Canadian Mineral Rubber Company, Ltd., in which there was practically no question as to there having been an infringement, and the matter before the court was as to the validity of the patent, No. 88,116, which is identical with U. S. Patent No. 727,505; and this was fully sustained by the court. This is the first case under the Canadian patent, but the United States patent has been sustained in several decisions.

Another decision that has recently been rendered in relation to this pavement was in a case where the city of Rochester had specified this pavement, a proceeding which it was claimed was prohibited by the charter. The court decided that this was a distinct "kind of pavement" and was not "a particular kind, make, style, or brand of material" which could not be specified under the charter.

### Home-made Fire Extinguishers

IN many situations, especially in rustic localities, an abundance of hand grenades for extinguishing fire is a very necessary precaution. Many persons who hesitate to provide themselves with sufficient store of these because of the expense will be glad to know that they can easily be manufactured at home at a trifling cost. A late number of *La Nature* gives three new inexpensive formulas for solutions which make excellent grenades when placed in mineral water bottles, which are easily broken when required.

Hagnard grenades are flasks containing not quite a liter of the following solution:

| | |
|---|---|
| Calcium chloride | 157 grammes |
| Magnesium chloride | 56 grammes |
| Water | 797 grammes |

Howen grenades contain a scant half liter of the following solution:

| | |
|---|---|
| Marine salt | 200 grammes |
| Sal ammoniac | 90 grammes |
| Water | 710 grammes |

The Schwenberg "Death to Fire" grenades contain a trifle less of the following mixture:

| | |
|---|---|
| Marine salt | 65 grammes |
| Solvay salt | 17 grammes |
| Water | 928 grammes |

---

**A Novel "Get Out and Get Under."**—Patent No. 1,136,327 to Frank A. French of Pittsburgh, Pa., provides a repairman's truck which is adapted to receive a repairman and his tools and is low enough to roll under an automobile. It also has a convenient headrest and is designed to add to the comfort and facilitate the work of the repairman.

## Correspondence

*[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]*

### Rufus Porter, Founder of the Scientific American

To the Editor of the SCIENTIFIC AMERICAN:

My acquaintance with Rufus Porter began a comparatively short time before his death.

In 1879 I was running a printing office in Meriden, Conn., and a man came in one day, and asked about some printing which he wanted. He had a fiddle-bag, and a fiddle in it, and I judged him to be one of the old-time fiddlers and dance masters.

He seemed advanced in years, and yet not an old-appearing or an old-acting man. I would have placed him at about 65 to 70 years of age, instead of the 80 or so which he actually was. He was of medium height, not over 5 feet 6 or 7 inches, I judge, eyes of light blue or gray, as I remember them, not requiring glasses, except for reading. The general impression that he gave was that of sturdiness.

He had evidently a well-stored mind, and was an interesting talker on the subjects of conversation which came up in our interview.

Such was Rufus Porter, founder of the SCIENTIFIC AMERICAN, a typical Yankee of the old school, one who could turn his mind and hand to many things.

He wanted some printing to use, and as he was lacking money, he wanted to make an exchange of some service he could render to pay for it, and feeling an interest in the old man, I allowed him to paint a sign, and did him the printing he wanted. Afterward he came again, and wanted to exchange a fiddle and a spy-glass for some more printing. I accommodated him, and kept them for more than a dozen years afterward. I was told by some one who knew him that Porter never used the cars in his travels, but always trudged on foot to his destination. I think that he would have tired out many a younger man.

It may be of interest in these days of the automobile and its tremendous development to know that Rufus Porter was working on the plans of an automobile, and was planning to form a company to manufacture the same.

He showed me the sketch of one, neatly drawn on brown or buff drawing paper. A steam carriage, he called it. The plan was that of an ordinary carriage, with a boiler placed underneath, and using oil as a fuel. The engine was of the rotary principle, with chain drive.

Such was his outlook at his advanced age.

In the non-utilization of his capabilities the world suffered an economic loss. He ought to have had a conservator over him in the shape of a captain of industry, or of some syndicate, who would have kept Porter's fertile mind at work on new ideas, backing them up with capital and business push, and then the world would undoubtedly have been the gainer.

*Richard M. Hoe.*

In strong contrast to Rufus Porter was another man, whom I met about three years after meeting Porter; this was Richard M. Hoe, head of the great printing machinery firm of R. Hoe & Co.

Mr. Hoe came into fame by reason of his noted invention of the type-revolving printing press about the time of the founding of the SCIENTIFIC AMERICAN. His main patent was issued in 1844, the year previous to the founding, and another important one in 1847. As I remember him, Mr. Hoe was a small man, probably not larger than Rufus Porter. He attained fame and fortune; Porter did not, yet I am inclined to think that the latter was fully as richly endowed mentally as the former, and even more so in physical toughness.

Mr. Hoe was brought up in a business of which he became the head, and in it he spent his life. He made a remark which may be considered as an epitome of his life-work in contrast to Porter's. In our conversation I expressed my doubts as to the probability of machinery being ever built absolutely perfect. Mr. Hoe deliberated a moment, and then said, "Well, we try to get down a little closer, a little finer each year, and we think that we do it."

Mr. Hoe gave to the world his best, and was an economic success. The conception of Rufus Porter—a journal for the diffusion of scientific knowledge—was a rich conception for humanity: by the labors of those who continued the SCIENTIFIC AMERICAN this one production of his was redeemed from failure, and has been a splendid economic success.

Hartford, Conn. RICHARD ATWATER.

---

**In a patent,** 1,137,393, Newell T. Fogg of Sanford, Me., discloses an apparatus for throwing the rays of sunlight into the throat and surrounding parts for the purpose of killing bacteria which may have secured a lodgment therein.

# A Mercury-Vapor Engine

## Increasing the Efficiency of a Heat Engine by Employing a Liquid of High Boiling Point

TO the layman the word *thermodynamics* suggests something abstruse, something perhaps remotely connected with practical things. Yet one of the fundamental conclusions from the principle of thermodynamics is as intensely practical as it is unexpected. The maximum efficiency of a heat engine working between a temperature $t_2$ of the boiler and $t_1$ of the condenser is wholly independent of the working substance (steam, hot air, gasoline, etc.), and depends solely on the temperatures $t_2$ and $t_1$. It is a common fallacy, among persons not well versed in these things, to suppose that for an engine working at a low temperature (as for example in the exploitation of the sun's radiation) some volatile substance, such as ether, would offer advantages over water. As already stated, this is not the case, the efficiency is wholly independent of the nature of the working substance, given a stated temperature of boiler and condenser.

Yet Mr. W. L. R. Emmet, working in the research laboratories of one of our most progressive industrial enterprises, has recently spent much time and effort developing an engine which uses the costly element mercury in place of water in the boiler. How is this to be harmonized with what was said above? The explanation is simple enough. It is true that the theoretical maximum efficiency of a steam engine working between, say, 677 deg. Fahr. (the boiling point of mercury at atmospheric pressure) and 100 deg. Fahr., would be exactly the same as that of an engine in which mercury vapor took the place of steam. *But*, a steam engine working at such temperatures would be impracticable, owing to the enormous pressure to which the boiler would be subjected. A mercury vapor engine can be, and has been, built to work effectively at the high temperature stated. And the higher the boiler temperature, the greater the efficiency.

To recapitulate, the nature of the working substance has no *direct* influence upon the efficiency of the engine. Indirectly it affects this efficiency, in so far as it determines, owing to practical considerations, the temperature at which the engine can be worked.

This, then, is one reason for Mr. Emmet's labors in perfecting a mercury vapor engine.

But there is another point to be considered. The steam engine, as commonly operated, is extremely wasteful in one particular: The combustion of coal furnishes a temperature of some 2,700 deg. Fahr. The proper conditions are, therefore, presented for obtaining a high thermodynamic efficiency. But owing to the properties of steam a large amount of heat must be allowed to go to waste through the stack, and, though a temperature of 2,700 deg. Fahr. is available in the furnace, actually only about 600 deg. Fahr. (using a superheater) can, at the very best, be made use of in the cylinder. Now Mr. Emmet does not propose to work his mercury vapor independently, but to intercalate it between the furnace and the steam boiler, so that all the advantages of the steam engine will be obtained as before, and the additional power furnished by the mercury vapor engine will be a net gain.

Whether the type of engine developed by Mr. Emmet is destined ultimately to figure prominently in industrial operations is perhaps at the present moment somewhat open to doubt. The prospect seems fairly promising, as will be seen from the description given below. In any case Mr. Emmet's engine presents many features of the very highest interest, owing to the peculiar conditions which have been faced and the ingenious manner in which the problems involved have been solved.

The method applied in his process is described by Mr. Emmet in a paper read before the American Institute of Electrical Engineers, as follows:

"Mercury is vaporized in a boiler heated by a furnace of ordinary type. From this boiler (see Fig. 1) it passes at a pressure near or not much above the atmosphere, to the nozzles of a turbine which drives a generator or other utilizer of power. From this turbine it passes to a condensing boiler where it is condensed on the outer surface of tubes which contain water, and this water is vaporized by the heat delivered, and the steam produced is used to drive other turbines or for any other purpose. This condensing boiler is preferably placed at a level above the mercury boiler, so that the condensed liquid will run back into the mercury boiler by gravity without the aid of a pump. Since the mercury vapor is much hotter than the steam, the gases will normally leave the mercury boiler at higher temperatures than they have in leaving a steam boiler. To utilize this excess heat in the gases, it is proposed to convey them, first, after leaving the mercury boiler through a heater which raises the returning liquid almost to the boiling point; second, through a superheater which superheats the steam delivered by the condensing boiler; and third, through an economizer which heats the feed water for the condensing boiler and so reduces the gases to the lowest practicable flue temperature.

"By careful study and experimental development, means have been devised for reducing the amount of mercury used, for effectively preventing its loss or dissipation, and for immediately detecting any failure in such prevention."

Mr. Emmet then goes on to discuss the disadvantages and the advantages of mercury for a heat engine.

"The disadvantages of mercury for such a process are: First, that it is very expensive, its cost being about 60 cents per pound. Second, that it is poisonous and is capable of pervading the atmosphere in a very finely divided state in the neighborhood of places where the vapor can escape. Third, there are certain difficulties in confining both the vapor and the liquid, although these, with proper methods, are not serious.

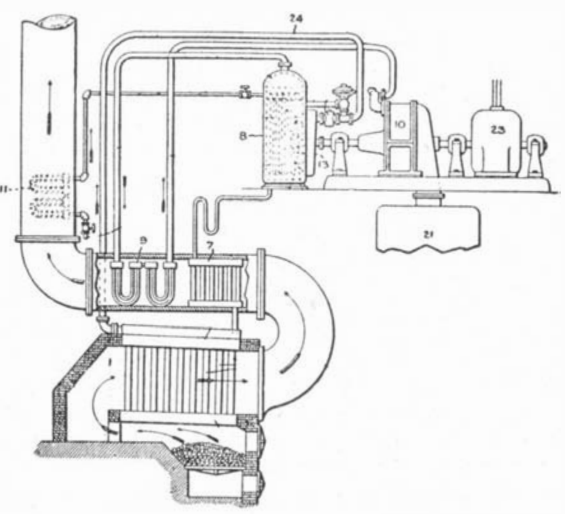


**Fig. 1.—Diagrammatic view of apparatus to generate power.**

1, mercury vapor boiler; 7, heater for liquid mercury; 8, condenser boiler; 9, superheater (steam); 10, steam turbine; 11, feed water economizer; 13, mercury turbine; 21, steam turbine condenser; 23, electric generator; 24, mercury vapor pipe.

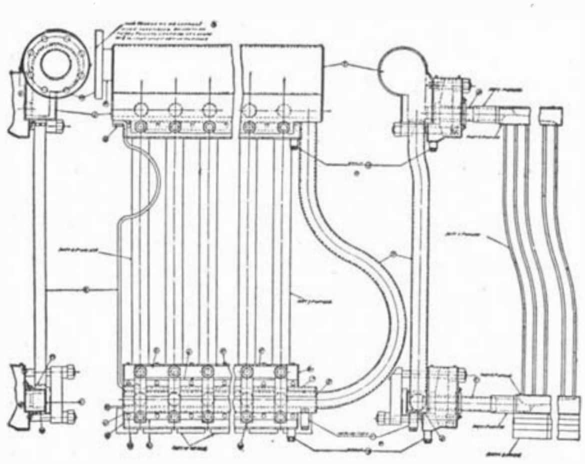


**Fig. 2.—Assembly of experimental mercury boiler.**

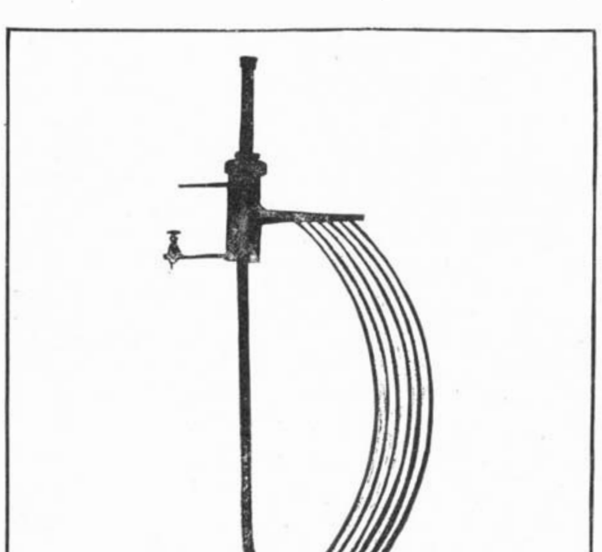


**Fig. 3.—Second experimental mercury boiler tube.**

"Mercury's advantages as a thermodynamic fluid for the purpose desired are many. First, its boiling points at desired pressures are convenient. Second, its high specific gravity makes possible the use of gravity feed, sealing of valve stems, etc., and centrifugal sealing of turbine packings. Third, it is completely neutral, at the temperatures used, to air, water, iron, and such organic substances as it may come in contact with. Fourth, it carries nothing in solution which can adhere to or affect heating surfaces, consequently the interior of boiler is always perfectly clean. Fifth, its vapor density is so high that it gives a very low spouting velocity, and consequently a very simple type of turbine can be used. Sixth, it does not wet the surface of turbine blades and consequently gives apparently no erosion. Seventh, its volume at convenient condensing temperatures is such that it can be used in turbines without excessive bucket heights. One of the greatest limits of design in steam turbines is the large area required for the efficient discharge of the low-pressure steam. With mercury vapor, this difficulty does not exist. Eighth, delivering its heat at the temperature and in the manner which it does, the condensing boiler in which this heat is used to make steam is very small and simple as compared with a steam boiler. Steam boilers transmit an average of about 6 watts per square inch with an average temperature difference of about 1,100 deg. Fahr. A surface condenser transmits 18 watts per square inch with 20 deg. Fahr. temperature difference. The mercury boiler is about equivalent in dimensions to a surface condenser, and since there is no high temperature involved, there will be no possibility of scaling or burning. High temperature, unequal distribution of heat, and the necessity for large heating surface constitute the principal difficulties of boiler construction. All of these are overcome in this method of making steam."

As regards the economy to be gained by his process, Mr. Emmet remarks:

"Before entering into the details of experiments or of the methods by which it is hoped to accomplish these results, it may be well to state the degrees of economy which should be accomplished if this development succeeds. Assuming heat deliveries to surfaces exposed equal to those in steam boilers under equivalent conditions of temperature difference, gas velocity, and radiation, and assuming a turbine efficiency equal to that of steam under equivalent velocity conditions, the calculation shows that in an efficient modern power station the same amount of steam can be delivered to the turbines at the same superheat, thus giving the same turbine output, and that in addition about 66 per cent of the power so delivered can be delivered by mercury turbines, the fuel required being only about 15 per cent greater than that which would be used with the steam alone. Thus the gain in capacity of an existing station would be approximately 66 per cent and the gain of output per pound of fuel would be about 44 per cent. This calculation is based upon a mercury vapor pressure 10 pounds above the atmosphere and a vacuum of 28.5 inches at the steam turbine outlet.

"About 10 pounds of mercury would be evaporated for each pound of steam produced, the steam pressure being about 175 pounds gage, superheat 150 deg. Fahr., and the final temperature after gas leaves economizer being about 300 deg. Fahr. The vacuum in both steam and mercury turbines can be maintained by the same air pump, means being employed to separate all mercury vapor from the air in a suitable cooler.

"Experimental data indicate that not more than $10 worth of liquid mercury per kilowatt output of mercury turbine will be required for such a process, and it is probable that with suitable arrangements, this amount can be considerably reduced. The general application of such a process would require immense quantities of mercury, but inquiry has indicated that the sources of supply are such that the largest conceivable demand for such a purpose would not permanently increase the price."

Mr. Emmet then proceeds to describe his mercury boiler:

"With a view to developing a design for a mercury boiler which would produce the vapor with the practicable methods of firing without destructive temperatures in the steel and with a small total amount of mercury in use, it has been necessary to do much experimenting to determine the behavior of mercury under boiler conditions. The construction of the boiler as finally developed is shown by Fig. 2, and the experimental unit used to determine its characteristics is shown by Fig. 3.

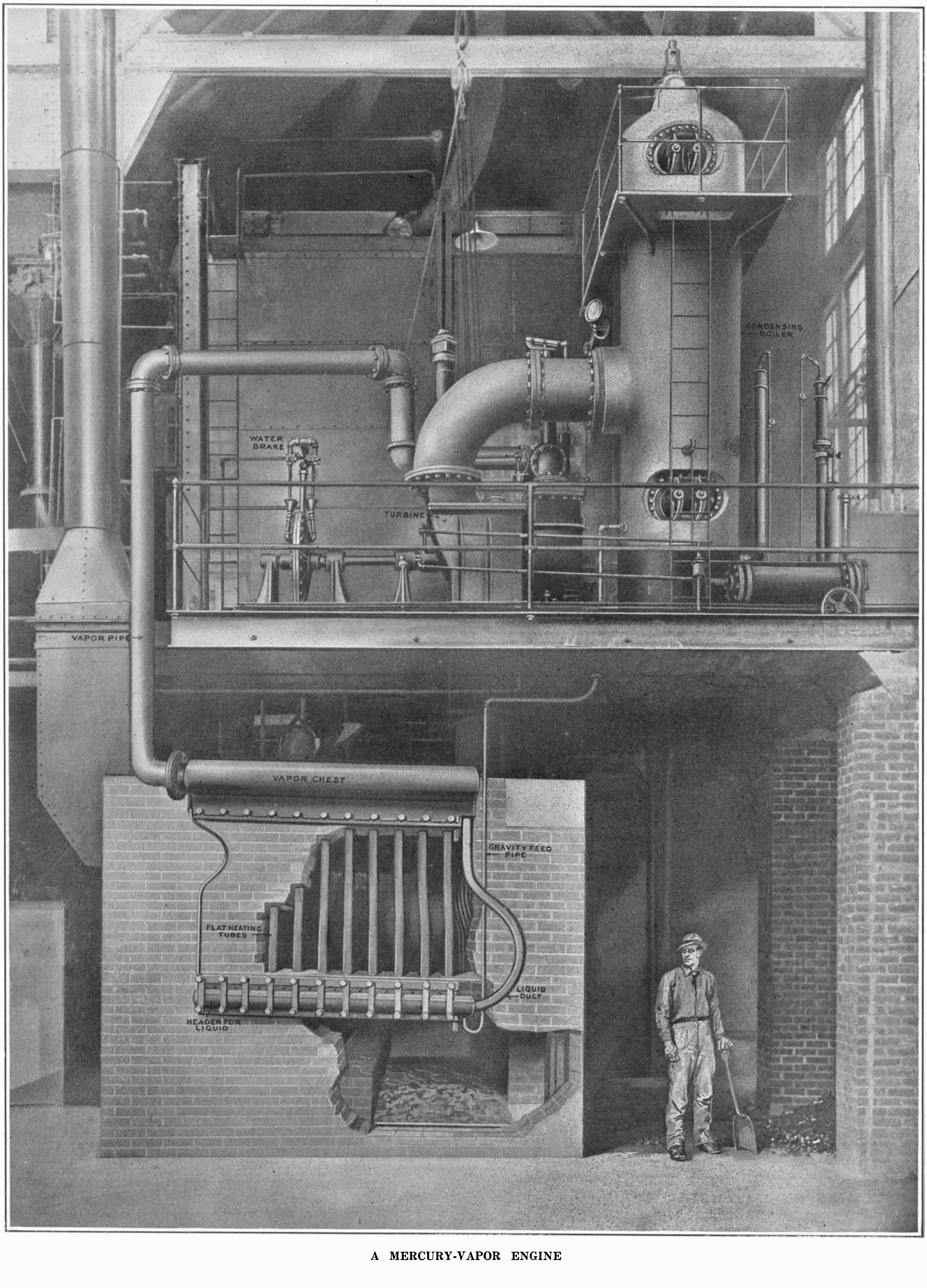
"This boiler is made up of a number of heating units, each consisting of an upper and a lower header which are connected together by curved flattened tubes. The flattening is to reduce the space which must be filled with liquid mercury without diminishing the surface. The curvature is to prevent mechanical strains through unequal expansion caused by irregular heating. These flattened tubes are connected into the headers by acetylene-welded joints. The tubes are first welded from the inside into channel-shaped pieces; these channels with the set of tubes connecting them are then annealed so as to release all strains incident to the welding. After annealing, they are tested with high-pressure air, suitable clamps being used to confine the air in the channels. These channel pieces are then welded to steel headers so that the whole unit becomes perfectly tight and capable of standing a high pressure. The headers of these units terminate in taper nozzles, which fit into taper holes in the bus header at the bottom and into a vapor chest at the top. A curved liquid duct connects the vapor chest to the bottom header at the hot end so that the heating units which are exposed to the greatest heat receive the most direct supply of liquid. In these hot units, a larger internal space will be allowed than in the units which occupy the cold part of the boiler, so that the colder part will not carry an unnecessary amount of liquid.

"The arrangements of the turbine have been improved as the result of experience. The first turbine arranged was made from an old experimental steam turbine, and had many joints which were difficult to keep vacuum-tight. The new experimental turbine has only one joint, arranged in a manner which has been experimented with and which will avoid leakage.

"The condensing boiler used in the experiment now in preparation is made from a standard high-pressure feed heater having a water space at the top and bottom connected by tubes in the manner customarily used in such devices. This boiler has apparently worked satisfactorily and produced steam from mercury vapor in the manner expected. It is not, however, considered a suitable design for the purpose, since the temperature differences impose a strain on the expanded tube sheets. It is thought that tubes attached at one end with concentric circulation after the manner of the Nicholaus boiler will afford the most satisfactory method

for such condensers. Since no violent temperature differences will exist, it is believed that these condensing boilers can be made practically free from deterioration and entirely free from leakage."

**The Kashmir Shawl Industry** has not only declined since the days of our grandmothers, when it gave employment to over 60,000 people, but has also sadly deteriorated, according to Consul Henry D. Baker, who has been writing a series of able and voluminous reports on the commercial and economic conditions of all parts of the Indian Empire. France was formerly the best market for these shawls, and the industry experienced its greatest setback from the calamities attending the Franco-German war. Many of the best shawl weavers have left Kashmir and settled elsewhere, while others have taken to carpet making or embroidery. French patterns and new colors, such as magenta, are beginning to prevail over genuine Indian designs and colors, and the goods are rather cheap and showy instead of being real works of art as heretofore.




A MERCURY-VAPOR ENGINE

# The Heavens in June

## Studying the Acceleration of the Moon

By Henry Norris Russell, Ph.D.

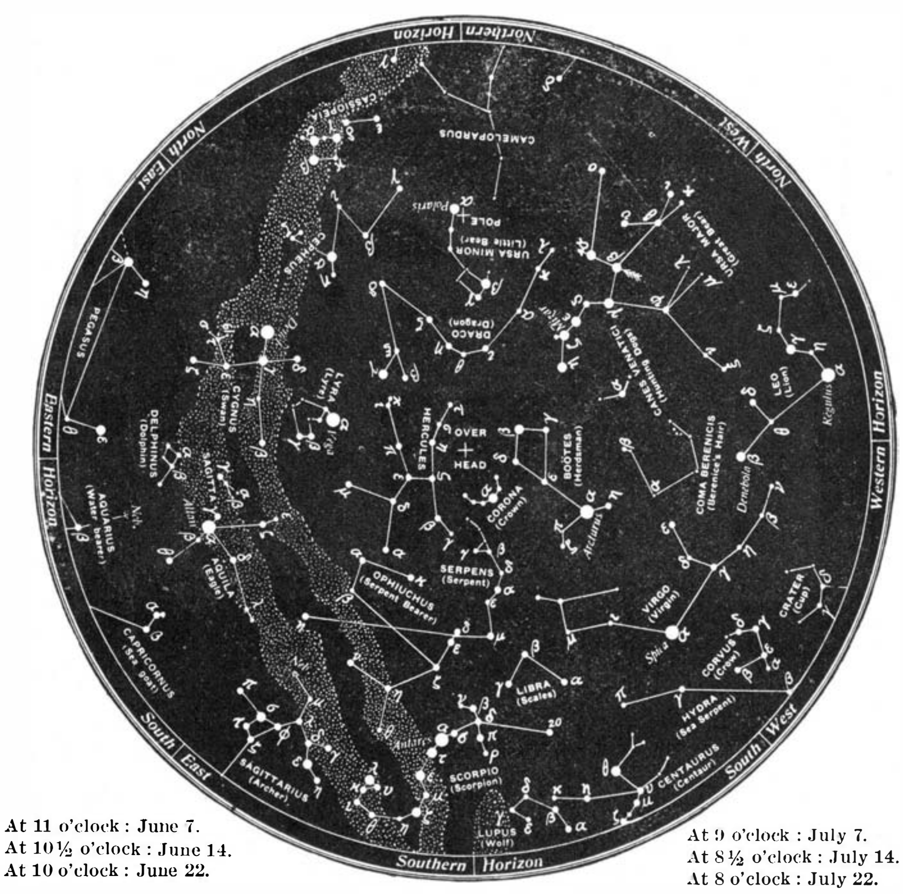
IN certain branches of astronomical research there has gone on for centuries a rivalry between the observer and the mathematician, which Prof. Brown of Yale has wittily compared to the contest between the makers of cannon and armor-plate. The mathematican, equipped with the tools of modern analysis, attempts to forge an invulnerable theory of the matter of some heavenly body—for example, the Moon—while the observer, to test the strength of the theoretical construction, batters at it with an ever-growing artillery of observational facts. But in this friendly contest the observer has a great advantage; in Prof. Brown's phrase, he has "a gun whose power increases with the time." However accurately the theorist may calculate the future course of the Moon, knowing only that at a given time it was in a certain position and moving in a given direction and at a given rate, he must depend upon observation to tell him what this position and this speed was; and it is clear that, the longer the interval of time over which our observations of any moving object extend, the more accurately we can determine its rate of motion. It is for this reason that the few ancient observations of the Moon which have come down to us, though made with the unaided eye, and very roughly, are still of importance. If her motion were exactly uniform, after correction for the well-known periodic "inequalities" which set her alternately forward and backward at regular intervals, it would be possible to work out its rate so accurately from the telescopic observations of the past 150 years that we could carry it back to classical times and compute her position then more clearly than the observers of that day could possibly have observed it. But, as a matter of fact, the Moon's motion shows a small but undoubted "secular acceleration," which means that, from century to century, she appears to move a little faster in the sky. The effect in any one lifetime is very small. The length of a month (measured by the Moon's motion among the stars), which in 1900 was 27 days, 7 hours, 43 minutes and 11.493 seconds, is steadily decreasing, but it will take 3,400 years to change it by a single second.

It may seem incredible that so small a change can be detected at all; but its influence is cumulative, and increases with the square of the time, so that for a long interval it is important. Two thousand years ago, for example, the month was six tenths of a second longer than to-day. Its average length throughout the twenty intervening centuries must have been three tenths of a second more than at present. But in this time there were almost 27,000 (sidereal) months, so that the total effect of this small change in the length of each amounts to about 8,000 seconds, or more than two hours. If, then, we calculated the Moon's position 2,000 years ago, ignoring this change, and carrying its motion back at its present rate, we should go wrong by about 2¼ hours' motion of the Moon, which amounts to 1¼ degrees. This is more than twice the Moon's diameter, and could not fail to be recognized by the naked eye if good sky-marks were near the Moon, in the shape of neighboring stars, or if observations were made at the time of an eclipse.

For more than two hundred years, since the time of Halley, it has been known that the Moon's motion presented this peculiarity; but the determination of the exact amount of the change is very difficult.

The latest word upon the subject, published but a few weeks ago, comes from an English chronologist and astronomer, Dr. Fotheringham, who has worked out anew the results of certain ancient observations, recorded by Ptolemy in his classic treatise known to us under the Arabic name of the Almagest. In this work, written in Greek at Alexandria about 140 A. D., are recorded a number of observations of occultations of stars by the Moon, or close approaches of the Moon to certain stars, with such clear statements of the place, year, date, and hour of observation that there seems to be no doubt of their meaning. Seven such observations, the earliest made at Alexandria by Timocharis in the year 293 B. C., the latest at Rome in the reign of Trajan, in 98 A. D., are given by Ptolemy, and it is from these that Dr. Fotheringham has derived the value of the change in the length of the month which is given above. The average outstanding discordance between the positions of the Moon so calculated and those described by the ancient observers is slightly over a quarter of a degree. It is probable that most of this discordance arises, not from the estimates of the Moon's position relative to the stars, which could be made under favorable conditions with much smaller errors, but from the difficulty of determining the time of observation with the very imperfect means at the disposal of the ancients. It is believed that the time between the moment of observation and the preceding sunset—or the following sunset, in case of a morning observation—was measured by means of a water-clock. From the magnitude of the discordances, Dr. Fotheringham concludes that these small water-clocks, on the average, ran wrong by about twelve minutes per hour!

In spite of these difficulties which beset the work of the ancient astronomers, these few recorded observations suffice to fix the rate at which the month is growing shorter with a "probable error" of about one fifteenth of its own amount. If only we had all the observations on which they based their own calculations, we would be better off, as is shown by the fact that Hipparchus, fully 250 years before Ptolemy, was able to determine the length of the sidereal month (the average period of revolution of the moon among the stars) within two seconds of time—that is, within a millionth part of its true value—and the length of the synodic month (from new Moon to new Moon) within a small fraction of a second.




At 11 o'clock: June 7.
At 10½ o'clock: June 14.
At 10 o'clock: June 22.

At 9 o'clock: July 7.
At 8½ o'clock: July 14.
At 8 o'clock: July 22.

At 9½ o'clock: June 30.

NIGHT SKY: JUNE AND JULY.

The ancient observations of eclipses show that the Moon's daily motion, compared with the Sun's, is also growing more rapid, but at a slower rate than the motion compared with the stars, so that the Sun, too, must be moving a little faster per day through the heavens than once it did. According to Fotheringham, who substantially confirms an older investigation by Cowell, the Sun's "secular advance" amounts to about three seconds at the end of a century, which corresponds to a shortening of the year by a second and a half every century.

What the reasons are (so far as is known) for these singular changes in the lengths of the month and year we must leave to be told next month, only remarking here that, since we use the Earth's rotation as the standard in all our measures of time, a minute increase in the time required for this rotation, i. e., in the length of the day, would make the number of days in a month or a year smaller, and so cause an apparent decrease in their length, due only to the slowing of all our clocks.

### The Heavens.

As our map shows, the most brilliant part of the sky is now in the southeast and south. Its splendor arises less from the bright stars within its confines than from the magnificent region of the Milky Way, which extends from Aquila southward through Sagittarius into Scorpio. The great star-clouds in this neighborhood send us far more light than the individual bright stars in their vicinity, yet most of their light comes from stars too faint to be seen with any but the largest telescopes. The possessor of even a small instrument, however, will find innumerable fine star-fields and many beautiful nebulæ and clusters, which will richly repay his study. One cluster in particular, between λ Scorpii and γ Sagittari, is a splendid object, even in a field-glass.

Scorpio itself, now fully in sight, with the sweep of its tail curving down to the southern horizon and upward again, is the finest constellation in view. Following the Milky Way upward and to left, we reach Sagittarius; then, beyond the star-clouds, Aquila; later Cygnus, with Lyra above, and finally Cassiopeia, low in the northeast. Draco and Ursa Minor are high in the north, and the Great Bear is fully displayed in the northwest. Leo is due west and near setting, and Virgo is higher up, in the southwest. Boötes, Corona, and Hercules are grouped about the zenith, and Ophiuchus and Serpens are on the meridian in the south.

### The Planets.

Mercury is evening star until the 26th and morning star after that date. He is well visible during the first week of June, when he sets a little after 9 P. M., but disappears in the twilight before the middle of the month.

Venus is a morning star in Taurus and is now pretty near the Sun, rising at 3:10 A. M. in the middle of the month, just before daybreak.

Mars is likewise a morning star, in Aries and Taurus, rising about an hour earlier than Venus.

Jupiter is in quadrature with the Sun on the 19th and is due south at 6 A. M. on that date. He is in Pisces, close to the vernal equinox, and rises about 1:15 A. M. at the beginning of the month and 11:30 P. M. at its close.

Saturn is an evening star in Gemini and is very close to Mercury at the beginning of the month, but later falls below him in the sky, so that he will be the first of the two to be lost to view. On the 28th he is in conjunction with the Sun and becomes a morning star.

Uranus is in Capricornus, and comes to the meridian at 3:40 A. M. in the middle of the month. Neptune is in Cancer, visible in the early evening at the beginning of the month, when he sets at about 10:30 P. M., but lost in the twilight before its close. The Moon is in her last quarter just before noon on the 4th, is new at 2 P. M. on the 12th, in her last quarter at 9 A. M. on the 20th, and full at 11 P. M. on the 26th. She is nearest us on the 26th and farthest away on the 11th. She is in conjunction with Uranus on the 2nd, Jupiter on the 5th, Mars on the 9th, Venus on the 10th, Saturn on the 13th, Mercury on the 14th, Neptune on the 15th, and Uranus again on the 29th. The conjunctions with Uranus are close, but not observable from this part of the world; the others are wide.

At 7 A. M. on the 22nd the Sun reaches his greatest northern declination, and, in the phrase of the almanacs, "summer commences."

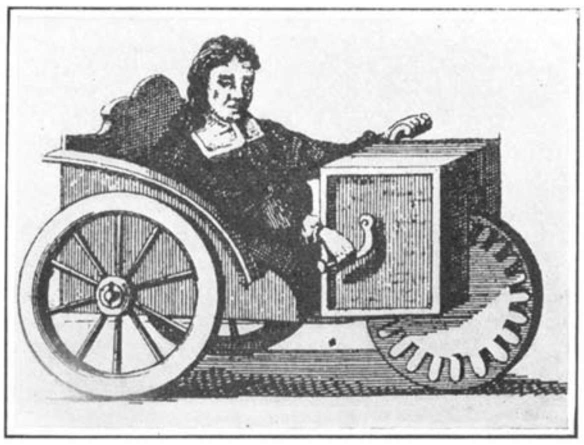
### Comets.

Mellish's comet, though a fine circumpolar object this month for southern observers, has disappeared from our view, to return only as a telescopic object, when it regains a declination at which we can observe it. It is probable that it can be followed telescopically all this year and the next.

A new comet was discovered on May 16th by Delavan at La Plata, Argentina. Its position, as communicated by telegraph recently, was in 0 hour and 33 minutes Right Ascension and 2 degrees 5 minutes south declination, which places it in the constellation of Cetus, about 15 degrees east and 1 degree north of the present position of Jupiter. The comet is described as "visible in a small telescope."

No information regarding its motion is available at the date of writing.

Princeton University Observatory.



An old German hand-driven wheel-chair.

## Measuring the Twisting Strength of Steel

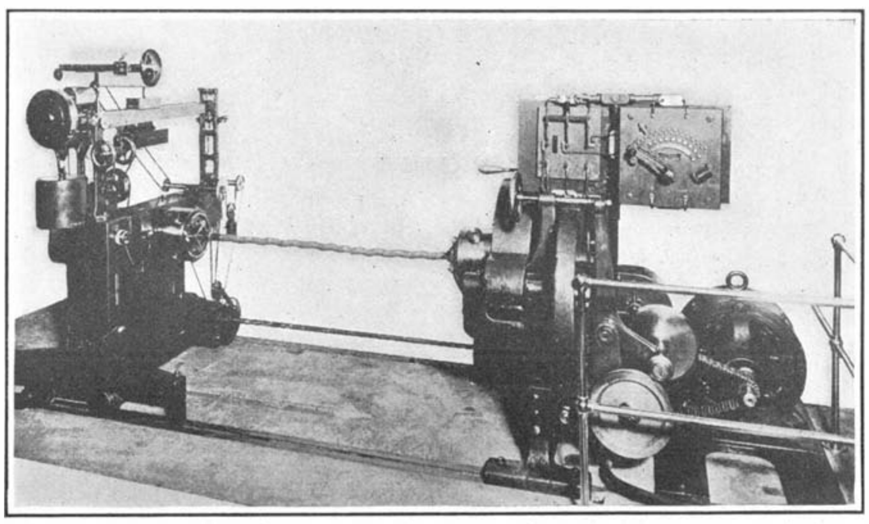
By Robert H. Moulton

THE manufacturers of a well-known motor car have just installed in their laboratory a new torsion testing device for measuring the twisting strength of steel. There is only one other machine of the kind in existence, which is now being exhibited at the San Francisco Exposition, and has been purchased by the Japanese Government.

The novel part of the machine is the autographic attachment, which records in ink the torsion curve of the particular part under test. Formerly this measurement was calculated more or less accurately by an attendant. The capacity of the machine is two hundred and thirty thousand inch-pounds. It will test round, square, flat, or irregular specimens from one eighth of an inch to two and one half inches in diameter, and up to eight feet in length.

The machine is operated by a variable speed motor and two systems of clutches. It is automatic and autographic, the balance weight being operated by an electric clutch, the curve of the autographic part being taken on a drum driven through differential gearing.

The specimen to be tested is placed in position in the jaws of the machine, the gearing thrown into operation, and from this point the human element does not enter, nor is the machine again touched by the operator until the broken pieces are removed. The autographic mechanism delivers a complete curve, showing the exact performance of the tested piece throughout the operation.



Machine for measuring the torsional strength of steel.

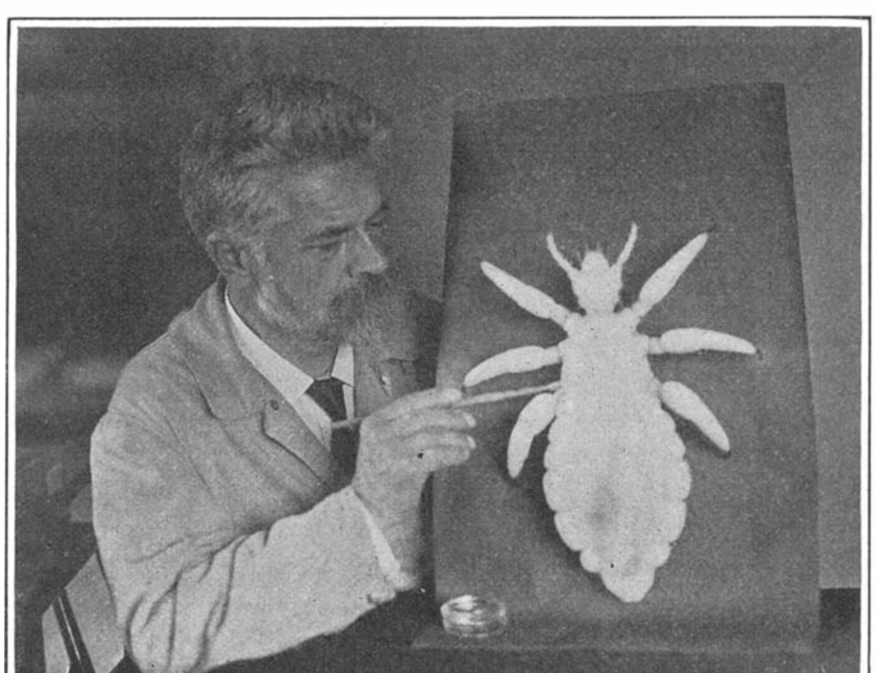
## Model of the Typhus Carrier

THE horrors of pestilence, a vermin borne disease, in addition to the awful sufferings on the battlefield, is the latest shock of the present European war, for the dreadful scourge of typhus fever has already claimed thousands of victims in Serbia. This deadly pestilence of olden times, which must be clearly distinguished from typhoid fever, has almost disappeared from civilized countries in times of peace, and is a striking example of the relation between *cleanliness* and *health.* Typhoid fever was once confused with typhus fever, and when it was recognized as a different disease it was named typhoid because it was like the more common and more deadly scourge. Typhus fever was formerly also called "*camp fever*" and "*jail fever*," because it raged so terribly under the unsanitary conditions which prevailed in these and other vermin haunted places. In every century typhus fever has followed in the wake of armies. During the Thirty Years' war it claimed more victims than did the weapons of the contestants. It was the terror of the Napoleonic campaigns, and decimated the French army, already demoralized physically and morally by the terrible retreat from Moscow. During the Crimean war it decimated both the French and English armies, especially the former.

It was only six years ago that a French bacteriologist, Nicolle, followed by several American investigators, showed that the germ of this disease is carried from person to person, mainly by the bite of the louse and perhaps, at times, by other vermin.

At this opportune moment there is being constructed at the Museum of Natural History, New York, a realistic and most accurately enlarged model of this devastating pest. It was planned under the direction of Dr. C. E. A. Winslow, curator of the Department of Public Health, and will shortly be installed in the new hall of this section. It is to be shown along with other previous enlarged figures of the mosquito, fly, and flea, which have been described in this journal. These are to form a part of a new and comprehensive military hygiene exhibit illustrating the dangers of insect-borne and other camp diseases now being assembled under the supervision of Curator Winslow. This human welfare exhibit might be said to be the first attempt made in a pure Natural History Museum to regard man as after all one of the most important animals.

The model of the louse, an illustration of which is reproduced, is being prepared by Mr. Matausch, an accomplished preparator attached to the museum, and will show the insect magnified a million times.



Enlarged model of typhus carrier in the Museum of Natural History at New York.

## The Evolution of the Wheel-chair

WHEN the wheelbarrow came into general use in Europe in the middle of the thirteenth century, it was described as being, among other things, "a comfortable means of transporting invalids and other persons," and we see in an early print taken from a sixteenth century manuscript, what may, perhaps, be a prototype of that wheeled conveyance, man-pushed, seen on the Atlantic City boardwalk to-day!

Long antedating the awkward wheeled conveyance of the thirteenth century, "invalids and other persons," including the dark-eyed beauties of the Orient, traveled more or less elegantly in litters slung on poles and carried by four bearers. Due, no doubt, to the lack of dignity in barrow riding (since we are assured of its comfort) the use of the hand-pushed wheeled vehicle of the sixteenth century did not become popular, and we find a reversion to the old-time palanquin in that the typical light vehicle of the eighteenth century is the Sedan chair.

This chair was a portable box with side windows and a roof which opened to allow the occupant to stand when entering. It was entered by a hinged doorway in front, between the two poles by which a pair of chairmen carried it. These chairs were often beautifully decorated, some of the greatest French pastoralists embellishing the panels with the most exquisite paintings.

Sedan chairs, with the poles so arranged that the chair was not tilted, were also used to carry invalids up and down stairs from their beds to mineral baths, and in connection with various baths and health resorts the use of the wheel Bath chair resulted. One can readily understand how being trundled around in a Bath chair would fail to satisfy a craving for locomotion, for the development of the motor chair seems to have come about not solely as an expedient for moving invalids, but also from the desire for the pleasure of speed without exertion. And so, mankind having at length grown dissatisfied with palanquins, wheelbarrows, Sedan and Bath chairs, we find an article in the *Journal de Paris* for the 27th of July, 1779, announcing the invention of the first velocipede.

A twentieth century electrically-driven wheel-chair.

This swift and fearful vehicle consisted of a wooden bar rigidly connecting two wheels placed one before the other, propelled by the rider seated astride the bar and pushing against the ground with his feet. This rare machine was called the "Gentlemen's Hobby-horse," and immediately became so popular that it was followed by a "Ladies' Hobby-horse," which was built with a neat seat like a lunch counter stool rising from a low bar near the ground so that the lady might scuff the path in a seemly manner. The hobby-horse, however, was halted in his wild career by the melancholy accusation that "this form of exercise gives rise to a disease of the legs." Thereupon an arrangement was developed whereby the front wheel was rotated by a hand-crank, for strange to say, a gearing for foot power was not thought of until considerably later. An odd type of an old hand-driven wheel-chair appears in a German print in Feldhaus' *Die Technik*, which shows an enterprising gentleman evidently using all his energy to push himself along.

The motor chair seems to have come into existence in connection with the bicycle from the cyclist's desire to take along as a companion a lady or invalid who could not do a share in the propulsion, for we find the pleasant pastime advocated in *La Bicyclette* (1899) wherein is described a two-wheeled wicker chair attached to a bicycle.

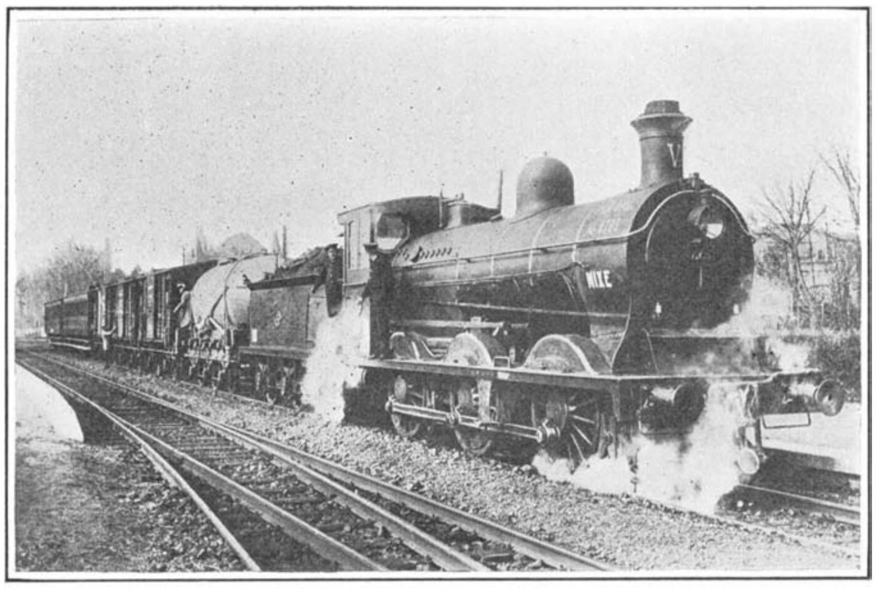
A different aspect of chair cycling appears in 1890. This was what was known as the "Coventry chair," a spacious tricycle with wicker body, behind which a man sat on a sort of footman's seat and pedaled, steering by means of a handle running under the chair-body from the small wheel in front. This elegant vehicle was declared to "fully meet the requirements of those who move in the inner circles of society." Thus we see the inception of the actual motor chair, and it is only a natural sequence that four years later there appeared in *London Work*, "Will you please give full instructions as to how to drive an invalid chair by electricity?" to which the following answer was given:

"To do this a motor that would develop about a quarter horse-power would be required, and this would have to be driven by means of accumulators. You would, I am afraid, find that the accumulators would take up a lot of room in the chair. and if you had no means of recharging them, you would require an engine and dynamo. I think that you will find the cheapest and most satisfactory way is to hire a boy to push the chair."

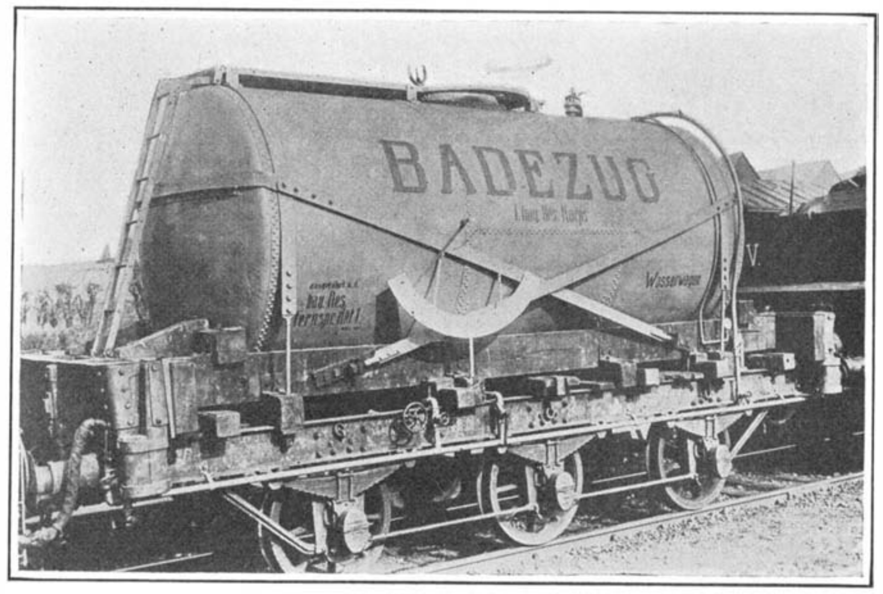
This suggestion, however, was a forerunner of the present day electric wheel-chair, which, however primitive it may appear a century hence, is certainly a marvel of ingenuity beside the hobby-horses of the past, and would have seemed a piece of witchcraft in the days of the early wheelbarrow.

This unique vehicle is attracting much attention just now at the San Francisco and San Diego Panama-Pacific expositions where several hundred are in opera-

(*Concluded on page 502*)

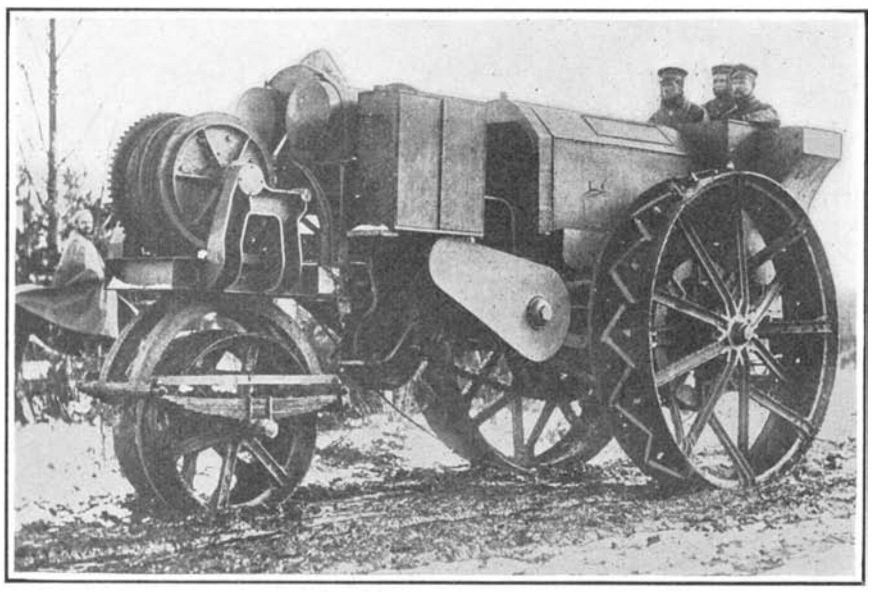


Bathing train of the German army.

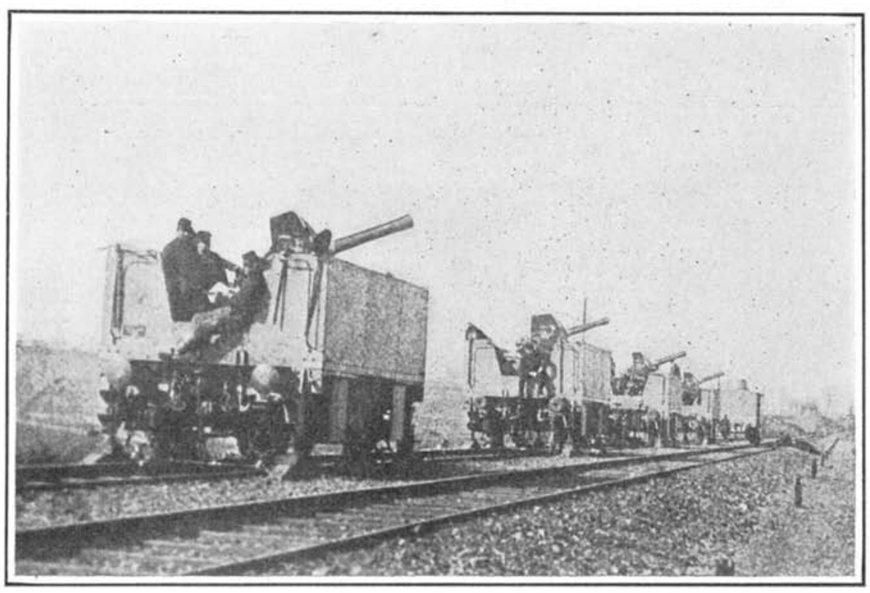



Copyright International News Service

The bathing water tank car.



Huge German tractor used in Poland.



Allies' mobile battery in Flanders.

## Mobility in Modern Warfare

THE accompanying random pictures will give some idea of what is demanded in the way of mobility in modern warfare. In Poland, where railroad facilities are very meager and roads are almost impassable in stormy weather, the warring armies have been confronted with almost insuperable difficulties. Motor trucks and powerful tractors have done heroic work in these emergencies. One of these tractors, an enormous gasoline-propelled machine, is shown herewith. It has been used by the German army for the transportation of heavy guns and trains of supply wagons.

The battery of guns mounted in armored cars was photographed in Flanders and shows how the Allies are enabled to move their artillery quickly from one point to another as occasion demands.

The other two photographs are of a more peaceful character, but also have to do with mobility.

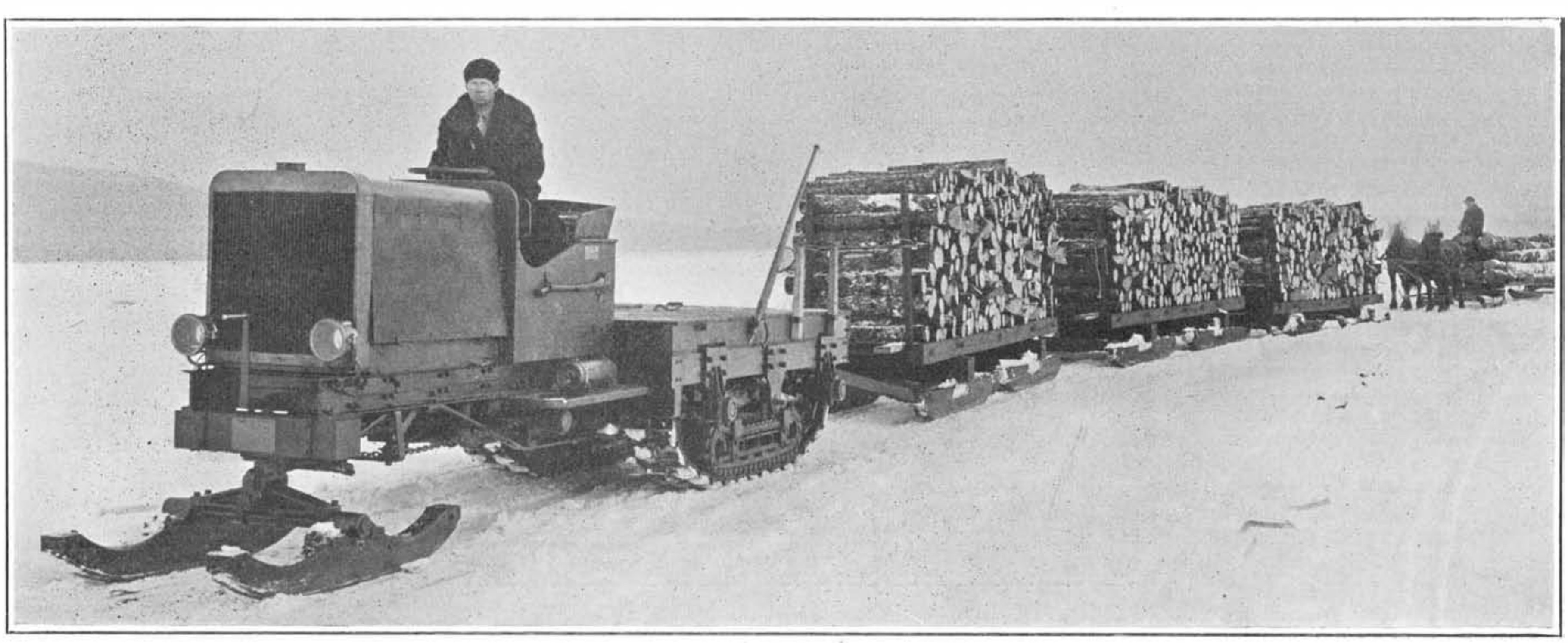
The German army has in use a train specially constructed for bathing, which can keep closely in touch with the men at the front. The train consists of a locomotive, tender, water tank car, three cars fitted up for hot baths, and several cars fitted with separate compartments. The tank car contains about 2,300 gallons of water, and about fifty soldiers can bathe at a time.

## Log Train Locomotive

GASOLINE has displaced steam at Brewer Lake, Maine, for hauling logs out of the North Woods. The accompanying photograph shows an interesting tractor on sled runners, which is equipped with a caterpillar type of propeller driven by a powerful gasoline engine. Caterpillar traction is ideal for travel through snow. The machine weighs seven tons as against thirteen or more, which is the common weight of the steam tractor. Some time ago this machine was wrecked by breaking through the ice of the lake when it encountered a triangular crack. The tractor went to the bottom, carrying with it the driver, who was drowned. The water is about fifty feet deep at that spot. However, the machine was raised and repaired. It is still at work when the ground is covered with enough snow, and can haul twenty cords at a load over common roads and bad hills.

**Making Electromagnets.**—An electromagnet is one of the most difficult things for an amateur to make without the use of machine tools. To make an electromagnet entirely by hand, the core is made of strips of thin sheet iron cut to the required size and assembled. A spool is made from sheet zinc by tracing out a figure that will fold around to make a square section to envelop the core, while the four ends are bent out at right angles to form the spool flange. But as such flange is incomplete, it is reinforced and also insulated by a heavy cardboard split washer which is fitted on. Wood should always be avoided on account of breakage. The main part of the spool can be insulated by a paper wrapping. Such a laminated magnet has the advantage of being flexible, and the poles can be spaced at different distances apart.

**A Novel Ball Rolling Toy.**—Domenico Ronconi of Chicago has patented (No. 1,132,796) a toy in which doll figures are seated one at each end and one at the middle of a table and motor mechanism beneath the table operates the arms of the dolls at the table end to roll a ball back and forth between the end dolls and also moves the head of the intermediate doll to cause it to appear to follow with its eyes the movement of the rolling ball.



A gasoline caterpillar tractor hauling a log train at Brewer Lake, Maine.

## RECENTLY PATENTED INVENTIONS

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

### Pertaining to Apparel.

APRON.—G. A. STEINER and W. F. TUCKETT, 33 E. 6th South St., Salt Lake City, Utah. This invention has reference particularly to aprons worn by butchers, bakers, waiters, bartenders, etc., and it is the object of the improvement to prevent the tangling and tearing of the tapes or tie strings during the washing process.

COSTUMER.—T. P. FORMAN, 95 Bank St., Waterbury, Conn. The standard or stem of the costumer is a tubular metallic member having integral feet formed at the bottom thereof by splitting the tube longitudinally and spreading the split portions outwardly and downwardly in radial relation to the stem, so as to provide a wide supporting base, the upper end of the stem having a head provided with a series of large and small hooks for supporting coats, hats and the like, said head being formed integral with the tubular stem or separate therefrom.

WARDROBE.—H. A. ROAT, JR., 1007 N. 3rd St., Harrisburg, Pa. The object in this invention is to provide a device especially designed for travelers, and having mechanism for permitting it to be easily attached to a fixed support or detached therefrom, and capable of folding into small compass for transportation and storage, and providing when in place protection for a number of garments of different character.

WARDROBE.

UNDERWEAR.—R. D. OILAR, Indianapolis, Ind. This invention has for an object to provide a garment having the characteristics of a union garment and form separable parts arranged end to end. It provides underwear substantially continuous throughout but separable substantially centrally, whereby there will be an upper and lower garment or part when separated.

### Electrical Devices.

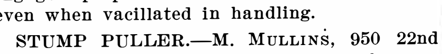
TERMINAL CONNECTION FOR SPARK PLUGS.—J. P. BLAUVELT, 234 North Broadway, Nyack, N. Y. This invention provides a terminal connection for spark plugs and similar devices arranged to permit of convenient attachment of a clip to the central electrode member of the spark plug and to prevent losing of the nut employed for fastening the clip in position on the spark plug.

SPARK PLUG.—J. A. GILBERT, Box 163, Cocoa, Fla. This invention provides a plug which is capable of giving a multiplicity of sparks, thereby insuring the explosion of gas in the cylinder upon which the spark plug is located. It provides a spark plug having a plurality of spark gaps in series, these gaps being arranged in a substantially circular arc around the bottom of the plug.

### Of Interest to Farmers.

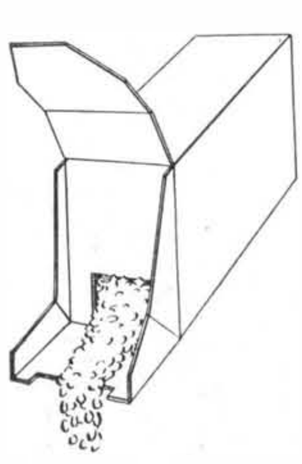
POTATO FORK.—A. H. KORTEUM and F. BAUS, R. F. D. No. 6, Long Prairie, Minn. The invention pertains to potato forks, and the object is to provide a simple, strong, and handy fork whereby potatoes or similar articles can be handled efficiently. The fork is adapted to engage a proper load and to maintain the same even when vacillated in handling.

STUMP PULLER.—M. MULLINS, 950 22nd Ave., Seattle, Wash. The inventor makes use of a frame provided with a longitudinal guideway, a driven drum journaled in the said frame, a cross-head or carriage mounted to slide in the guideway, sets of frame sheaves journaled in the frame, a set of cross-head sheaves journaled in the cross-head and arranged opposite the frame sheaves, a cable fixed at one end to the cross-head and winding at the other end on the drum, the cable passing around the frame sheave and the cross-head sheaves, and a flexible pulling connection engaging the stump to be pulled and connected with the cross-head.



STUMP PULLER.

CARTON.—S. GOODKIND, 825 W. 179th St., New York, N. Y. This invention provides a carton which may be used for keeping cereals clean and free from dust, the carton being so constructed that when it is opened, one of its parts will serve as a spout and another of its parts will serve as a means to retard the flow of the cereal from the carton to the spout.



CARTON.

### Of General Interest.

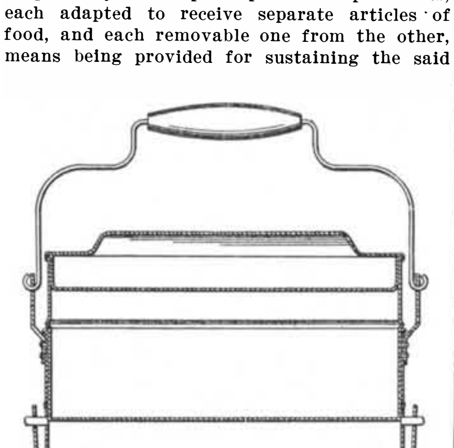
BRUSH.—C. A. FOGARTY, 39 Wyona St., Brooklyn, N. Y., N. Y. An object here is to provide a simple, convenient, inexpensive, and neat looking brush in which the bristles of the stock are doubled up so that the same cannot fall out from the support therefor. The invention provides a brush which reinforces the stock at the handle and thereby stiffens it.

MOLD FOR CONCRETING PILES.—G. S. CHAPMAN, 1035 Baum Ave., St. Petersburg, Fla. This invention relates to a means for applying a covering of concrete to piles after the latter have been driven. It provides a mold so constructed and arranged that it may be applied and removed from the piles in water of any reasonable depth without the assistance of a diver.

UMBRELLA. — KATHERINE C. HOUT, 13 Chestnut St., Schenectady, N. Y. This invention provides means for securing the cover in service relation rapidly and with increased facility; provides means for mechanically mounting the cover of an umbrella upon its frame; and provides metallic members for holding the cover on the frame, in lieu of conventional stitched constructions.

PROTECTIVE TURRET.—R. B. EVERETT, Yazoo City, Miss. This bullet-proof turret may be placed in a bank or similar building in which money or valuables are kept, or which may be placed in a prison, or mounted on an automobile, or mounted in the express or baggage car of a train, or any suitable car of a train, and which may be occupied by a guard, who is protected from bullets or shots of a burglar or robber, the construction being such as to allow the guard to shoot from within the turret with a minimum chance of himself being harmed.

DINNER PAIL.—J. SHEWAN, Niagara Falls, N. Y. In carrying out this invention the purpose is to provide a dinner bucket comprising a plurality of super-imposed compartments, each adapted to receive separate articles of food, and each removable one from the other, means being provided for sustaining the said sections one above the other, the sections being telescoped one with the other, and the retaining means being also adapted to retain the sections or compartments when telescoped within each other, which thus provides a comparatively small package which may be easily carried by the user.

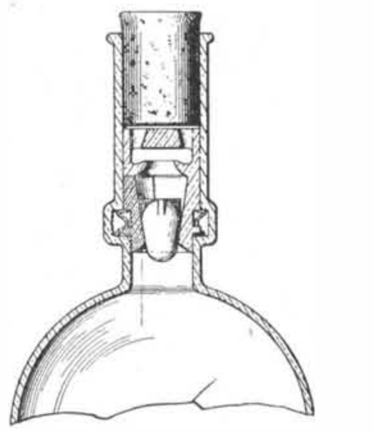


DINNER PAIL.

SEWER CLEANING MEANS.—A. BORNEMANN, 96 Main St., Bettendorf, Iowa. The prime object of the invention is to provide means whereby to hold the pressure of the flushing head in the sewer pipe and cause a sudden ejective impulse of the flushing water, whereby to effectively remove any collected matter from the sewer.

APPARATUS FOR DISPENSING BEVERAGES.—A. LANDGREBE, 1724 Barnes Ave., Van Nest, Bronx, N. Y., N. Y. Among the objects of the invention is to provide connections between a barrel or series of barrels of beer in a cellar and the faucets at the bar on a higher floor, such connections being of a peculiar construction adapting them especially for being readily cleansed and kept in a sanitary condition.

NON-REFILLABLE BOTTLE. — L. BERGER and G. A. HASSINGER, 307 Camp St., New Orleans, La. An object here is to provide a stopper which may be fitted into the neck of a bottle and which embodies means to permit permanent flow of the liquid from the bottle, but to prevent refilling of the same. The invention also provides means for preventing the retraction of the stopper from the bottle neck after the former has once been positioned therein.



NON-REFILLABLE BOTTLE.

SIPHON HEAD.—A. A. PRATT and J. ZOLLINGER. Address the former, 122 W. 20th St., New York, N. Y. The purpose here is to provide a siphon head arranged to permit of conveniently opening or closing it without the use of the elaborate mechanisms now generally employed. To accomplish the desired result, use is made of a spout mounted to rock in the cap of the head and controlling the outflow of the liquid.

CARTRIDGE HOLDER.—G. SERGEEFF, 4052 Market St., Philadelphia, Pa. The prime object of this invention is to provide a cartridge holder whereby to load simultaneously all the chambers of a magazine fire-arm. In carrying out the invention use is made of a plurality of individual elements, each being provided with means to detachably hold a cartridge.

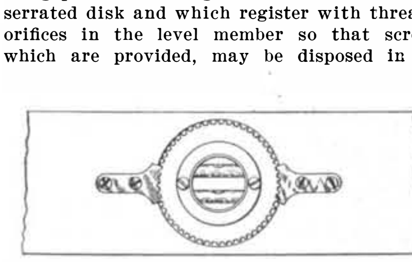
TRUNK.—M. CHERRY, JR., 226 5th Ave., New York, N. Y. This invention relates more particularly to an adjustable support adapted to carry the corner of a tray, or a hat or a similar object. An object is to provide a trunk which can be utilized with a tray, as an ordinary trunk, or as a hat trunk.

RECEPTACLE COVER AND SPOUT.—M. BLUME, 1405 8th Ave., Brooklyn, N. Y., N. Y. The invention relates more particularly to a cover and spout for a milk bottle. It further relates to a combination cover and spout for receptacles having means adapted to remove the receptacle stopper before the said combination cover and spout engages the mouth of the receptacle.

### Hardware and Tools.

STEP LADDER.—F. J. CARONIA, 1684 3rd Ave., New York, N. Y. The object of the invention is to provide a new and improved step ladder provided with side braces for steadying the step ladder sidewise, and arranged to permit of conveniently folding the side braces when folding the usual leg frame onto the back of the ladder.

LEVEL.—T. COUGHLIN, 1208 Clay Ave., Bronx, N. Y., N. Y. The level has a level member which is normally rotatably disposed in a circular opening in a frame, an annular flange being provided having orifices at recesses in a serrated disk and which register with threaded orifices in the level member so that screws, which are provided, may be disposed in the recesses for holding the level member in adjusted position. The level member is in two parts, which are normally held together so that the part with the threaded orifices may be moved away from the other part which moves the screws, to permit of a readjustment of the disk relatively to the teeth on the frame which engage the serrated edge of the disk.



LEVEL.

SAW JOINTER.—E. C. MANTEROLA, Calle Freire, No. 84 Quillola, Chile. The general objects of this invention are to improve and simplify the construction and operation of tools of the character referred to so as to be reliable and efficient in use, and so designed that the jointing or evening of the saw teeth is accomplished automatically as the tool is moved along the saw.

KNIFE BLADE.—T. A. BEECHER, Cochrane, Alberta, Canada. The purpose of this improvement is to provide a knife blade whereby in trimming the nails the knife will not cut the same to the quick, which blade will easily and quickly trim the nails without any danger of injury to the flesh and thereby blood poisoning set in.

PRUNING SHEARS.—W. R. BARR and H. A. BARR, 231 Grove St., Oakland, Cal. The shears are adapted to be employed for pruning the limbs of trees, the branches of bushes, or vines, and objects of the invention are to provide an arrangement of relatively movable blades whereby the force exerted by the user will be most effectively applied; to provide blades and operating means that will result in a clean, smooth cut without bruising the bark or injuring the pruned member, and to provide blades that may be sharpened with the greatest facility.

PRUNING SHEARS.

REAMING BITS FOR PROSPECTING DRILLS.—W. T. UNDERWOOD, 2230 Ridge Park Ave., Birmingham, Ala. The invention relates to reamers, or expanding bits, for use in drilling holes for prospecting, and for other purposes, fastening bolts in a rock in order to anchor structures, such as buildings, towers, bridges, trestles, etc. It provides a reamer or bit for enlarging the hole in those portions extending through troublesome strata in order to accommodate and fasten the protecting casings or sleeves.

COMBINED PIPE WRENCH, CUTTER, AND DIE.—E. A. NELSON, 210 E. 48th St., New York, N. Y. Among the objects of this invention is the provision of a tool or implement adapted to reach down into a casing beneath a pavement for the manipulation of a gas standpipe, the upper end of which is commonly located below the surface of the pavement within the casing.

DOUBLE ACTING LAVATORY HINGE.—O. KATZENBERGER, 215 West Huron St., Chicago, Ill. The invention relates particularly to an improved double acting hinge which may be easily fitted to a door or support of any thickness. It provides a hinge with a center having a barrel at each end arranged on one side thereof and associated with a box flange designed to connect the hinge with a support.

THREAD GAGE.—C. L. BAILEY, 37 Herman St., Glen Ridge, N. J. The inventor provides a thread gage more especially designed for use by machinists and other mechanics and arranged to enable the user to quickly and accurately determine whether the thread of a screw, bolt, tap or similar threaded article is of the correct size or not.

PERSPECTIVE FINDER.—O. V. HUMANN, 18 Walnut St., Worcester, Mass. The invention provides means for ascertaining the correct perspective angle of distant objects; provides means for demonstrating the convergence of boundary lines of said objects and shows the vanishing point for perspective drawings; provides for aiding and teaching elementary perspective and free hand drawing, and more particularly in the teaching of the rules relating to, and for familiarizing the scholar with the method followed in applying the same to perspective drawing; and provides means for disposing in definite arrangement, the field of vision to which a drawing is to be limited.

### Heating and Lighting.

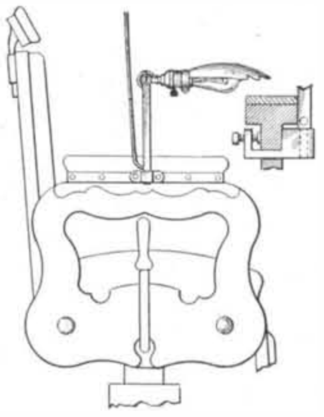
ELECTRIC WATER HEATER.—C. H. QUINLAN, Amsterdam, N. Y. The invention has for its object to provide for conveniently and quickly heating a quantity of water or other liquid. Among other advantages, the invention is handy and ready of application; it is useful in the sick room and for general purposes; and it is a great boon especially for house renters and house-rooming people.

WINDING DEVICE FOR DROP LIGHTS.—C. V. JOHNSON, 616 Shrader St., San Francisco, Cal. This invention relates to extension or

drop lights for electric fixtures, and deals more especially with improvements in the construction of a winding mechanism for the flexible electric cord. The apparatus is so designed as to be easily and quickly manipulated for adjusting the light to any desired position.

HEATER.—L. T. CRABTREE, Box 262, Crandon, Wis. The present invention is designed to provide a heater having the maximum heating capacity in proportion to the fuel consumption. A further design is to provide a heater that can be utilized for effectively ventilating a room or rooms.

LAMP FOR BARBERS' CHAIRS.—A. SCLAFANI, 157 47th St., New York, N. Y. This lamp is more especially designed for removable attachment to the arm rest of a barber's chair and arranged to strongly illuminate a man's hand for manicuring purposes. Use is made of a socket or a bracket attached to the arm rest of the chair, a post removably seated in the



LAMP FOR BARBERS' CHAIR.

bracket, an arm mounted to swing up and down on the upper end of the post and extending forwardly, and an electric lamp mounted on the arm to extend forwardly, the lamp being provided with a deflector to deflect the rays of light downward onto a hand resting on the arm rest of the chair in which the person is seated.

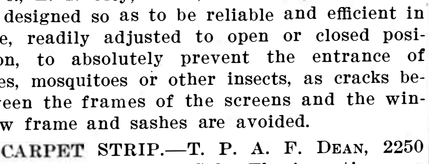
**Household Utilities.**

FLOOR POLISHER. — LILI A. MCGRATH, Brookhaven, Miss. The main object in this case is to provide means for accomplishing the result in a pleasurable manner. A further object is to provide such means which utilize the weight of a person using the same. A further object is to provide such means in the shape of foot coverings, such as slippers adapted to be worn by the user.

PERCOLATOR.—W. D. COLLINS, 1963 Daly Ave., Bronx, N. Y., N. Y. The objects of the inventor are: to avoid boiling of the coffee while making the same; to pass heated water through the ground coffee once only; to provide an independent receptacle for the liquid coffee; to avoid cooling the heated water while elevating the same for delivery upon the coffee pack and also avoid heating the liquid coffee in its receptacle; and to avoid breaking the glass cover.

WINDOW SCREEN.—E. SONNTAG, 246 9th Ave., L. I. City, N. Y., N. Y. This invention is designed so as to be reliable and efficient in use, readily adjusted to open or closed position, to absolutely prevent the entrance of flies, mosquitoes or other insects, as cracks between the frames of the screens and the window frame and sashes are avoided.

CARPET STRIP.—T. P. A. F. DEAN, 2250 E. 20th St., Oakland, Cal. The invention provides an arrangement wherein nails, tacks and the like may be used for holding carpet in place when used on stone or cement floors. A



CARPET STRIP.

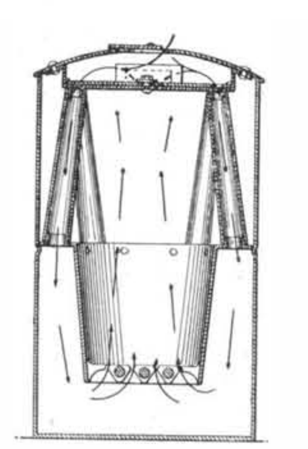
metallic strip receives a nail or other securing means for holding carpet in place, the strip being arranged so as to be readily used on floors, stairs and other places where it is desired to place a covering.

ASH AND GARBAGE CAN.—H. BAUMAN, 61 E. 4th St., New York, N. Y. The invention provides a form of can or body wherein one side of the latter is flat so that the cover of the can can be thrown to open position behind and against the flat side of the body, so as to be out of the way, the cover being permanently attached to the body of the can both in its open and closed position, so that the cover cannot become lost, injured or otherwise rendered useless.

WASHBOARD.—MARY S. KJELLSTROM, 110 E. 41st St., New York, N. Y. The object of the invention is the provision of a new and improved washboard arranged to permit of rubbing the clothes over the corrugated surface in the usual manner and to allow of washing the clothes while in a tub by rubbing and suction action.

FLUSHING DEVICE.—F. W. O. KRETER, 225 Blain St., San Antonio, Tex. One of the main objects in this case is to provide a device which is readily applicable to any closet tank. A further object is to provide means operable by the closet seat for setting the device and resilient means for raising the valve when said seat resumes its normal position.

STOVE.—H. J. SCHUYLER, 337 E. Market St., Louisville, Ky. This invention relates to heating stoves, and provides such a stove wherein the air supplied to the fuel is preheated, thereby resulting in great fuel economy.



HEATING STOVE.

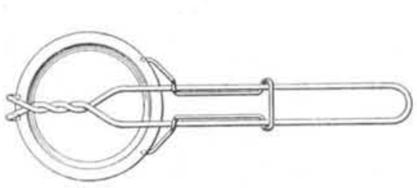
It provides top, intermediate, and lower chambers, the first of which is adapted to be placed in communication with either the lower chamber or with the escape flue of the stove, in the normal operation of the stove, or to prevent back-draft when the stove door is opened.

WINDOW CLEANER.—L. SONDEREGGER, 1564 Crotona Park East, Bronx, N. Y., N. Y. The cleaner is arranged to permit the user to conveniently attach it to or remove it from the window sill, and to allow of simultaneously cleaning both the inner and outer faces of the window pane with any desired pressure of the wipers against the faces of the pane as required.

HUMIDIFIER.—E. J. BRAUN, 557 W. 42nd St., New York, N. Y. The object here is to provide an improved humidifier more especially designed for use in rooms and associated with a radiator or other heating medium to supply moisture in an ample quantity to the surrounding atmosphere with a view to properly moisten the same.

CLOTHES LINE SUPPORT AND ADJUSTER.—F. LUERSEN, care of George Nelms, Price, Utah. The object of the invention is to provide an improved clothes line supported on posts or equivalent elements and having associated therewith novel adjusting means. The pins are so clamped to the clothes that the latter will form a connection between adjacent pins and the hauling of those pins will result in drawing the pins and clothes in succession toward the support, and by a reverse movement the clothes may be conveniently hung and removed.

PAN AND PLATE LIFTER. — ELLA D. SCHMITT, 126 Loraine Ave., Upper Montclair, N. J. The aim in this invention is to provide a pan and plate lifter in two pieces, which are constructed of wire bent to obtain the greatest



PAN AND PLATE LIFTER.

possible strength with the least weight. The construction permits the free movement of one of the pieces along the other for engaging the hooks on the pieces with a pan or plate or for disengaging them therefrom.

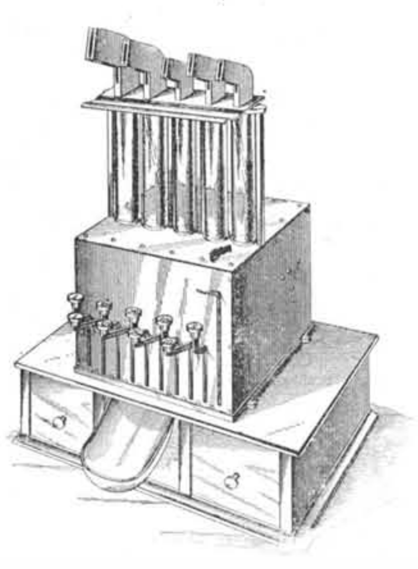
**Machines and Mechanical Devices.**

CIGARETTE MAKING DEVICE.—J. PRESTON. Address Samuel S. Preston, Box 829, Asheville, N. C. More particularly the invention is designed to produce a device by means of which a cigarette wrapper may be rolled and filled with a fine cut tobacco of the general character employed in what is known as Cuban cigarettes, although the device is applicable for forming cigarettes from tobacco generally.

DEVICE FOR REPLACING AND ADJUSTING COILS IN FIELD GUNS.—J. SMITH, 46 Brooklyn Ave., Brooklyn, N. Y., N. Y. The device can be easily and quickly applied to a field gun, which will obviate the present use of block-and-fall with the abutting members necessary therefor, and by which device the resetting or adjusting of the recoil can be easily and quickly done without using any of the other field pieces of the battery for abutment or other purposes.

LINE ADJUSTER FOR TYPE WRITER PLATENS.—J. M. FRAAZ, 533 Canal St., New York, N. Y. This invention provides an attachment adapted to be added to any usual or conventional form of typewriting machine to which the attachment is applicable for the purpose of adjusting the platen or roller to any desired extent less than the full space adjustment.

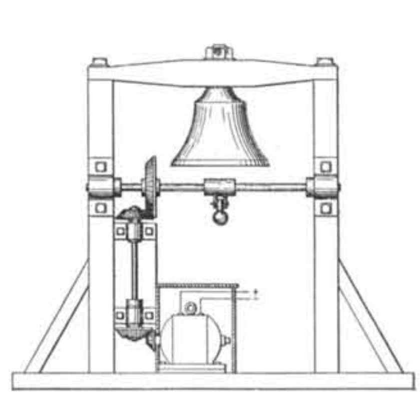
CHANGE MAKING MACHINE. — G. HOFMANN, 1949 Berteau Ave., Chicago, Ill. The inventor provides a machine for use by cashiers and other persons for quickly and accurately making change either with or without pennies. In accomplishing this use is made of a series of coin magazines for containing stacks of coins



CHANGE MAKING MACHINE.

of different denominations, coin slides for receiving the lowermost coins from the said stacks of coins, one or two sets of setting keys for setting the said coin slides according to change to be made, and an ejecting key for moving the set coin slides to eject coins from under the stack of coins.

BELL RINGING DEVICE.—H. D. ELLIOTT, Skamokawa, Wash. The invention relates more particularly to a fog bell, in which a fixed bell is employed and is automatically sounded at predetermined intervals. The prime object of the invention is to provide in association



BELL RINGING DEVICE.

with the fixed bell, an independent, revolubly mounted clapper or striking device arranged to give a plurality of sounding strokes against the bell in any desired rapidity of succession, the striking periods occurring at the desired intervals.

WATER FILTER.—H. L. KUENZLI. Address Kuenzli Bros., Nevada, Ohio. This invention provides a removable screen that may be taken out and replaced or renewed, and provides mechanism in connection with the screen and the filter for preventing loss of water through the opening for the discharge of the impurities by splashing or by capillary attraction. The filter is entirely sanitary, every part being accessible, and it is self-cleaning.

DEVELOPING MACHINE.—C. K. NESHIME and S. J. Rognlie, Minot, N. D. The object here is to provide a device by means of which a film may be developed, rinsed and fixed without the necessity of touching the film with the hand. It provides a device in which a longer film may be placed in the machine in such a manner as to insure no part of the sensitive surface of the film coming in contact with any part of the apparatus.

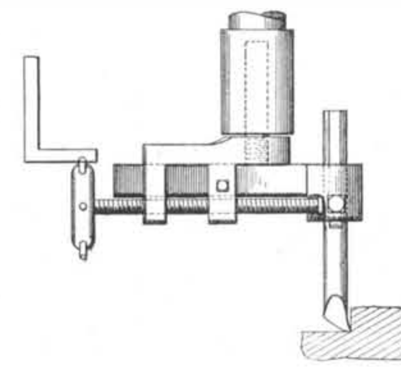
TRAP.—G. W. MORTHLAND, 202 W. Main St., Lead, S. D. The invention provides a device wherein a holder is provided, having means for supporting bait, and means for receiving and holding a cartridge, and the holder is provided with normally active mechanism for exploding the cartridge, the said mechanism being normally held in inoperative position by a trip, which is released by the animal, when the animal attempts to release the bait.

AUTOMATIC STARTING AND STOPPING DEVICE.—F. B. DAVENPORT, 806 Coal Exchange, Wilkesbarre, Pa. The improvement refers to means for controlling the operation of machinery, and has particular reference to means for automatically shifting the belt of a belt driven machine from the tight to the loose pulley or *vice versa*, depending upon the mass of material moving toward the machine.

WELL PUMP.—G. E. WHITE, care of Union Club of South Africa, Johannesburg, South Africa. This invention has for its object to provide an inexpensive, simple and balanced pump. To carry this object out the inventor employs a pump having a reciprocating plunger actuated by a tubular rod and having a valve controlled opening. The pump is principally constructed for operation with a wind motor.

CENTRIFUGAL DEVICE FOR FILTERING SUGAR JUICES.—L. G. G. DIBBETS, Badhuisweg 12 Schweningen, The Hague, Holland. This mechanism is for use in the filtration of defecated or carbonated sugar juices by centrifugal means. The invention provides a device by means of which sand, sawdust, bagasse or other filtering material may be placed and used within the basket of the sugar centrifugal and the juices to be filtered may be caused to pass through this layer by the action of centrifugal force.

DRILL ATTACHMENT.—C. SWANBERG. Address Geo. F. Williams, Cadillac, Mich. This attachment is for use with hand or power drills for converting the drill into a planer designed to operate upon disks, pulleys, mandrels, and like circular or cylindrical bodies, wherein a support is provided having means for engaging the drill stem to constrain the



DRILL ATTACHMENT.

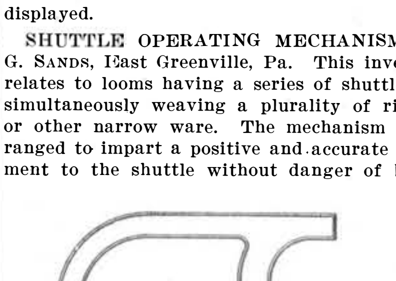
support to rotate therewith, and a holding bar mounted for movement on the support radially with respect to the drill stem, and provided with means for supporting a bit or tool for revolution about the axis of the stem, together with mechanism operated by the revolution of the bit or tool for feeding the bit or tool.

DRILL.—I. LAPIDUS, 593 Gates Ave., Brooklyn, N. Y., N. Y. The drill has an arm rotatably mounted on a motor, this arm having a section which is rotatably mounted on the body of the arm on an axis extending longitudinally of the arm body, the section of the arm having bearings on which a spindle is journaled, the spindle being rotatable by a belt connected with the motor shaft and being movable longitudinally of the axis of its bearings to carry a tool secured to the spindle into operative position.

MACHINE FOR PREPARING RUBBER.—J. E. POINTON, Engineer, Westwood Works, Peterborough, England. This machine is of the type in which a batch of washed crude rubber is subjected to the action of rotating blades or their equivalent arranged in intercommunicating chambers. The invention provides for the more ready and effective drying or mastication of the said rubber and incorporation therewith of the usual ingredients required to adapt it to meet various services.

ADVERTISING DEVICE AND THE LIKE. —H. K. HARRIS, care of Browne & Co., 9 Warwick Court, Holborn, London, W.C., England. The more particular purpose in this invention is to provide means, controllable from a distance by a controlling apparatus, designated as a jacquard, in such manner as to display a number of legends or intelligible signs so arranged as to act as a visual signal, the jacquard being adapted for controlling within reasonable limits the character of the signals displayed.

SHUTTLE OPERATING MECHANISM.—G. G. SANDS, East Greenville, Pa. This invention relates to looms having a series of shuttles for simultaneously weaving a plurality of ribbons or other narrow ware. The mechanism is arranged to impart a positive and accurate movement to the shuttle without danger of break-



SHUTTLE OPERATING MECHANISM.

ing the operating straps. To accomplish this, use is made of a rack bar provided with a pin engaging a spiral groove formed in the peripheral face of a roller driven alternately in opposite directions by suitable means connected with the crankshaft.

SELF DUMPING SCOW.—F. P. EASTMAN, 142 E. 27th St., New York, N. Y. The scow is arranged to permit of safely carrying a load

to a dumping place out at sea, to permit almost in any kind of weather discharging the load without requiring extra power, and to prevent the scow from being unduly strained when subjected to the heaving, pounding action of a rough sea.

SHAPING ROLLS FOR HORSESHOE BARS.—L. T. PAGE, P. O. Box 104, Wareham, Mass. This invention provides for mechanically creasing and partially punching the bars from which horseshoes are subsequently made; prevents the creeping or misregistering of the rolls with the bars and shoe-forming sectors thereof; and reduces the friction offered to the bars by the rolls when passing therethrough.

PROCESS OF AND APPARATUS FOR MAKING RECEPTACLES.—E. A. CLAUS, 156 67th St., Brooklyn, N. Y., N. Y. This invention relates to a process of making receptacles such as milk bottles and the like, and refers more particularly to a process of this kind, which consists in introducing plastic material into a mold, in causing the viscous material to be spread upon the inner surface of the mold, and in introducing fluid under pressure into the mold to press the material against the walls of the same.

BORDER CUTTING MACHINE.—W. H. WALDRON, care of John Waldron Co., New Brunswick, N. J. The invention relates to the manufacture of wall paper, and its object is to provide a machine arranged to enable the attendant to keep the design printed on the border in register with the cutting roll, to insure accurate cutting of the border along the contour of the imprint.

STAMP SUPPORTER FOR CIGARETTE BOX STAMP APPLYING MACHINES.—J. IBARRA, Habana, Cuba. This invention has for its objects the provision of means for supporting the stamps in outstretched relation beneath one of the delivery positions of the box, where the same is placed to receive the stamps; and to provide means for preventing misregister of the stamps employed with the boxes to be supplied therewith.

PICKER HEAD CHECK.—A. A. PERKINS, 22 Minerva Ave., Sanford, Maine. The aim of the invention is to provide certain improvements in picker head checks whereby the varying qualities of the cam are increased and the spring for pressing the cam is concealed within the same, thus forming no undesirable projections.

PROCESS OF AND APPARATUS FOR MAKING RECEPTACLES.—E. A. CLAUS, 156 67th St., Brooklyn, N. Y., N. Y. The invention relates to a process of making receptacles such as milk bottles and the like, and more particularly to a process which consists in introducing plastic material into a mold, in causing the viscous material to be spread into the inner surface of the mold, and in introducing fluid under pressure into the mold to press the material against the walls of the same.

WORK TABLE GUARD FOR POWER PRESSES.—J. W. SWEENEY, 117 W. 79th St., New York, N. Y. This improvement refers to automatic guards for use in connection with the work table of punching, stamping and other power presses, whereby the workman is prevented from keeping his hands in such position with respect to the work that they are liable to be injured by the machine in performing its operation.

ADVERTISING CLOCK.—H. MILLER, 110 Greene St., New York, N. Y. This inventor provides means for projecting to any suitable distance and forming in any desired size the simulation of an illuminated clock face. He provides means for projecting time, in the manner stated, in a satisfactory way to different distances, and providing also means for displaying upon the clock face a suitable advertisement.

PAPER FEEDING DEVICE.—J. L. THOMPSON, Greensburg, Kan. The object here is to provide mechanism for connection with the printing press, and comprising forwarding and receiving magazines for the printed matter, together with mechanism for feeding the sheets from the forwarding magazine to the press, and from the press to the receiving magazine, the mechanism being automatic and fluid controlled.

POCKET CUTTER.—A. B. CAMPBELL, JR., care of Campbell-Ware Co., Jacksonville, Fla. In this patent the invention is an improvement in pocket cutters, and has for its object to provide mechanism for quickly and easily cutting pockets in the jambs of window frames, for receiving balanced sashes, wherein the cutting is done by a continuous moving chain.

### Musical Instruments.

DULCIMER ACTION.—N. J. WINLUND, 727 Loomis St., Rockford, Ill. This invention provides an action in which the hammer is caused to strike a string and immediately recede therefrom, thus permitting full vibration of the string. Means provide for carrying a note when a key is held depressed after striking a string, said means maintaining a damper out of string engagement in this depressed position of the key, but allowing the damper to bear on said string when said key is released.

### Railways and Their Accessories.

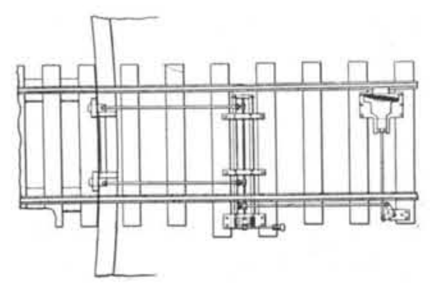
METALLIC TIE.—G. F. BROCKWAY, R. F. D. No. 4, Box 76, Eden Township, Iowa. This invention relates to metallic ties for railways, and more particularly to one of the hollow metallic shell type. It enhances the utility of a rail tie such as disclosed in Mr. Brockway's former Patent No. 1,103,652. It arranges and constructs a hollow metallic tie that will embody a minimum amount of material and at the same time possess the requisite rigidity and strength.

AUTOMATIC TRAIN STOP.—F. K. WADE, care of The Texas Co., 146 Summer St., Boston, Mass. This invention relates to devices for automatically stopping railroad trains when the latter run by signals set at danger against them. It provides an arrangement of electrical devices on each engine which may be operated by means of circuits completed by a series of third rails or short conductors disposed along the track.

RAILROAD SAFETY DEVICE.—C. H. GOODPASTURE, care of Byron Millett, Olympia, Wash. The improvement relates to railroad safety devices of a type suitable for giving warning to operatives on board a moving train, in the event of the occurrence of a landslide, a snowslide, or other like casualty making a substantial disturbance in the condition of the roadbed. More particularly stated, it comprehends a safety device, controllable directly by physical action of the landslide or its equivalent, and associated with suitable alarm mechanism to warn the operatives upon the moving train.

RAILROAD SAFETY DEVICE.

SAFETY DEVICE FOR RAILROAD TURN TABLES.—J. T. SHERIDAN, Bowling Green, Mo. This improvement provides means which will lock a turn table when it is positioned relatively to a track to receive a locomotive on the track and which will automatically dispose a stop block on one of the track rails when the turn table is unlocked to permit of the rotation of the turn table. The engraving shows a section of a track and a portion of a turn table illustrating the invention.



SAFETY DEVICE FOR RAILROAD TURN TABLES.

### Pertaining to Recreation.

FILM REEL.—H. J. RICKON, 201 Central Ave., San Francisco, Cal. The improvement relates to moving-picture projectors, more especially to the film magazines thereof, and the main object is to provide film magazines which dispense with the re-wind of the film after projection upon another spool now necessary to prepare the film for a subsequent projection.

### Pertaining to Vehicles.

COLLAPSIBLE CORE.—G. E. HORTON and C. S. WAGNER, 198 South Main St., Akron, Ohio. The object of this invention is the provision of a simple, strong, and inexpensive core which can be easily and quickly manipulated. This is attained by providing a core formed of a plurality of sections bound together by means of fixed and expanding rings.

RESILIENT WHEEL.—J. F. NETTLE, P. O. Box 1057, Butte, Mont. In this instance the invention has reference to improvements in resilient wheels, and has for an object the provision of an improved structure wherein the resilient effect of a pneumatic cushion is provided without liability of puncturing of the cushion.

GRADOMETER.—W. J. SPAULDING, 1905 Cleveland Ave., Santa Barbara, Cal. The improvement in this case has reference to devices for measuring inclinations or grades with reference to a horizontal line, and has reference more particularly to devices for use in connection with automobiles, for indicating the grade of the road.

SUPPORT.—F. H. EVANS, Hewes St., Brooklyn, N. Y., N. Y. The object here is to provide a support for portable devices and apparatus used, for instance, as heaters for tar, pitch and other materials, portable kettles, driers, etc., and arranged to permit of quickly changing the support from supporting to folding position and *vice versa*.

DIRECT DRIVE TRANSMISSION.—W. D. PARSONS. Address E. L. Marvin, executor of Estate of W. D. Parsons, deceased, Joliet, Mont. The device is particularly adapted for use with automobiles or other motor-driven vehicles in which final drives of different speeds are provided instead of the ordinary single final drive. Means provide for shifting the drive shaft of the motor or engine from one position to another in order to engage and operate the various final drives.

VEHICLE TIRE.—R. L. LEACH, P. O. Box 18, Honolulu, Hawaii. Among the various objects of this invention are: To render the tire casing and the tire both readily detachable from the rim, and also to enable the tire to drop off the rim or at least to be easily detached therefrom, when the tire is dilated; to provide anti-skidding lugs, and means for securing them in position and for holding them to the casing and the tire; to give the rubber of the tire such form that its outer surface is irregular in order to fit the different shaped members of the tire casing; and to improve resistance against punctures and abrasions and to provide for enabling the metallic portions of the tire casing to take up and sustain the pressure of the tire due to inflation thereof.

BRAKE.—F. FRAME, Sawyer, Kan. This invention relates to brakes of a type admitting of general use, but of special service in connection with wagons, carriages, automobiles, cars and other vehicles, the more particular purpose being to provide a brake wherein the rotation of a wheel of the vehicle furnishes most of the motive power for actuating the brake.

FEEDING DEVICE.—A. ENSOR, 28 Roosevelt Ave., Jersey City, N. J. In order to accomplish the object of this invention, use is made of brackets permanently attached to a shaft or pole of a vehicle, a supporting device removably engaging the said brackets and a feed receptacle removably held on the said supporting device.

WAGON-BODY.—J. MCDERMOTT, 372 Vernon Ave., L. I. City, New York, N. Y. The purpose in this invention is to provide a simple, strong, convenient, and inexpensive wagon-body of the built-up type which can be easily and quickly assembled into a rigid structure and which can be used with animal or motor-propelled vehicles.

BRAKE DRUM FOR VEHICLE WHEELS.—N. CORNFIELD, care of The No-Shock Wheel Co., 1476 Broadway, New York, N. Y. The improvement provides a drum with a flexible connection between said drum and the vehicle driving wheel; provides a drum with a suitable driving sprocket wheel; and provides a yielding connection for said wheel with said drum.

VEHICLE WHEEL.—W. L. HOWARD, care of Howard Demountable Rim Co., Trenton, N. J. The main object of the present invention is to provide means in connection with the structure shown in Letters Patent No. 1,031,341, for preventing the creep of the rim; a further object is to accomplish this result by a relatively slight change in the wedges and gripping members shown in said Letters Patent, and without any alteration in the parts of the device, therein shown, as to general arrangement or operation.

VENDING MACHINE.—O. J. HOTALING, Johnson, N. Y. This invention relates to machines for vending or dispensing newspapers, periodicals, sheet materials and similar articles, and has reference more particularly to a machine in which is provided a movable article-support so arranged that the displacement of the articles from the support is gravitationally resisted, whereby the topmost article of the number on the support can be readily dispensed by sliding it from the next one thereunder, without tending to displace the last-mentioned article.

### Designs.

DESIGN FOR A BADGE.—L. A. MCDONAGH, Linden, N. J. This ornamental design for a badge comprises a soldier's helmet, at the top of which is perched an eagle with elevated wings and holding in its beak three spread-out pendant balls.

DESIGN FOR A MOTOR CAR BODY.—ELZA N. HOWE and HATTIE C. ARCHAMBEAU. Address the former, 966 E. Burnside St., Portland, Ore. In this ornamental design for a motor car body, the latter is shown in three views, viz., a side elevation, a rear elevation, and a front elevation.

DESIGN FOR A PAPER DISPLAY BOX.—L. HIRSCHFELD, 416 W. 45th St., New York, N. Y. In this ornamental design for a display box, the figure is a perspective view of a long, low and narrow paper box showing the new design.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

WE wish to call attention to the fact that we are in a position to render competent services in every branch of patent or trade-mark work. Our staff is composed of mechanical, electrical and chemical experts, thoroughly trained to prepare and prosecute all patent applications, irrespective of the complex nature of the subject matter involved, or of the specialized, technical, or scientific knowledge required therefor.

We also have associates throughout the world, who assist in the prosecution of patent and trade-mark applications filed in all countries foreign to the United States.

MUNN & CO.,
*Patent Solicitors,*
233 Broadway,
New York, N. Y.

Branch Office:
625 F Street, N. W.,
Washington, D. C.



## INQUIRIES

*Inquiry No. 9443.* Wanted the name and address of manufacturers of fuel oil burners and fire wall equipment, suitable for a maximum quantity of water evaporation in a locomotive firebox of the following dimensions: 2½' between door and flue sheet, 3' between grate level and crown sheet, 3' between side walls.

*Inquiry No. 9444.* Wanted the name and address of a manufacturer or patentee of a glass preserving jar made for use with air pumps for creating a vacuum.

*Inquiry No. 9445.* Wanted the name and address of a manufacturer who can make a combination pencil holder and point protector.

*Inquiry No. 9446.* Wanted the name and address of a manufacturer who can supply machinery for automatically wrapping cigars in thin imported tissue paper having the ends tightly wound and curled. Would consider purchase of machines or patent rights.

*Inquiry No. 9447.* Wanted to buy patented article, which is needed in every home, with a possible view to manufacturing and distributing.

## Storing the Tourists' Needs

(*Concluded from page 490.*)

improvement might be made. There are corners and cubby-holes all over a modern car that might be made of service to the car owner.

To this fact the designers are now waking up. There has been no increase in the external dimensions of cars; rather they seem to be getting slightly smaller, if anything. Yet the amount of space allotted the passengers is increasing. Nor has weight increased. Practically everyone knows that the car of 1915 is considerably lighter than the car of 1914. The movement has been all toward a reduction of weight coupled with an increase in capacity.

So, in a way, the designers have been forced to an ultimate utilization of every possible bit of waste space. The long running-boards which are such a prominent feature of long-wheelbase cars may be looked upon as waste space, but the dictates of fashion prohibit the placing of anything on them. Even the spare tire now has been relegated to a place of comparative obscurity at the rear of the tonneau. Nothing has remained but for designers to find a place actually within the body of the car, for the storage of such necessities as are not in reality a part of the car itself.

The placing of the gasoline tank at the rear with feed to the carbureter by the vacuum method, or by pressure, has released the space under the front seats where the tank formerly rested. This provides a roomy compartment. But there is the accompanying disadvantage that access to this compartment necessitates the disturbance of two passengers. And it must be remembered that comfort is now more than ever the fetich of the modern designer.

It is all very well to provide roomy compartments that are hard of access, and it is not altogether difficult. The problem is to provide such compartments in such places that they may be instantly accessible without the necessity for disturbing the passengers. And withal, these compartments must occupy some space that is not now put to some more useful purpose, such, for instance, as providing "stretching" room for the nether limbs of those who occupy the seats. No, we must not curtail the passenger room. What then?

There is, for example, the space beneath the flooring and between the chassis frame. This could hold a roomy receptacle which would be easily accessible simply by removing one floor-board. In somewhat the same category there are the spaces between the running-boards and the chassis frame on either side. They could be made into large compartments. Bodies in no case are solid; in the majority of cases they are mere shells of metal built on a wood or metal framework. Then why not utilize this space for the stowage of small articles, such as goggles, gloves, route books, and so on?

In addition to these body spaces, we have the doors to which we can turn our attention. In a great many cases, manufacturers now fit commodious flap pockets on the doors, but still greater use could be made of them. Like the bodies, they are largely mere shells. Why not a tool compartment in each door, with a place for each tool?

The large space underneath the deep cowls with which the modern car is fitted is a fertile field for exploration. Not all this room is required for the feet of the passengers. We have room here for several cupboards where the tourist might place such things as are in constant demand.

And now that the practice of placing seats in what military authorities would term *echelon* has become popular, there is a large space behind two of the seats that should not be permitted to go to waste. In some cases provision is made for carrying two suitcases in such compartments.

And, by the way, to revert to hollow shells of bodies, it is worthy of note that in several cases designers have provided for housing the top completely between the body and the framework, when the weather is fine. This surely is an advance that augurs well for the future.

The space beneath the turtle-decks with which a great many roadsters are fitted is not generally permitted to go to waste. Generally, it is used to house spare tires. But it is not always as accessible as might be the case. Doors at the side aid materially in permitting easy access to the compartments, particularly when they are used for purposes other than the storage of tires, as so often is the case.

The space between the front seats and the division in the car that marks the tonneau from the driver's compartment is another place where there is room for an exercise of ingenuity on the part of designers. This space might be utilized for a couple of large compartments with doors opening into the tonneau. Yet few makers have made such use of it.

Not all the waste space in the modern car has been made use of as yet, though it may be expected that ere another year has rolled around there will be not as much as there is now. And these new compartments and storage space that are coming into vogue cannot be looked upon solely as "selling features." They mark a distinct advance in the science of motor-car building—a fact which is being increasingly realized.

## The Evolution of the Wheel-chair

(*Concluded from page 497.*)

tion and where these are, in fact, the only conveyances permitted on the grounds. The battery-driven chair is becoming very popular at Palm Beach and other resorts, where at present it fully meets popular requirements. The electric is an exclusive chair in that two passengers can enjoy independence and luxury together with complete privacy from a porter's listening ears.

The chief feature of this motor chair lies in the utter simplicity of its operation and the complete control under which the driver has it at all times. Anyone can step into the chair and drive off without any preliminary lessons or possibility of accident, which makes it particularly adapted for amusement parks and the like. This is made possible by a peculiar construction of the mechanism. A small foot pedal actuates the braking mechanism and the controller under the floor of the car. By various pressures on the pedal the controller can be operated over four successive speeds ahead. Release of the pedal sets the brakes automatically. Twenty-four inches is given as the average distance which the chair will travel with brakes set.

Power is provided from an Edison battery of 10 cells having a capacity of 150 ampere-hours. The battery is placed in the box-like inclosure at the front of the chair body. A Westinghouse 12-volt, three eighths horse-power motor furnishes the propelling power. A double-reduction, chain and sprocket gear drive connects the motor and driving axle through an intermediate jack shaft beneath the seat. The speed of the chair is 4.5 to 5 miles per hour, just about a walking pace. The weight of the chair is about 300 pounds.

## Concrete for Churches

REINFORCED concrete is often used to advantage in church construction, and in some parts of Europe there are even examples of entire buildings being erected, such as the Cathedral of Poti, in Russia. Another use is for adding towers or spires in order to complete the unfinished church. It often happens that a church remains for a long time without towers or belfries, and these are built at a later date.

In order not to add an unduly heavy load on the already existing foundation, reinforced concrete has an advantage over stone work, and is besides less expensive. A good example is found in the Cathedral of Tunis, which was recently completed by putting on two high belfries in reinforced concrete, and these make up a good architectural *ensemble* with the former stone work.


ERICSSON


MORSE


EDISON


BELL


BLANCHARD


WESTINGHOUSE


WILBUR WRIGHT


TESLA

*The*

# 70th Anniversary

*NUMBER of the*

## SCIENTIFIC AMERICAN

**June 5th, 1915**


ORVILLE WRIGHT


MARCONI

THE Scientific American was founded seventy years ago, at a time when the United States of America was industrially less developed than South Africa at the present time. Even territorially, it was not the same country we know now; for California, Texas, and the great Southwest belonged to Mexico.

During that long period of seventy years the Scientific American faithfully chronicled the technical and industrial progress which we Americans made. Its editors saw the advent of the reaper, the telegraph, the telephone, the great trans-continental railways, the laying of the trans-atlantic cable, the development of the giant steamship, the perfection of the phonograph, the glow of the first electric incandescent lamp, the coming of the motion picture machine, the miracles wrought by wireless telegraphy, and more recently the conquest of the air.


THE SCIENTIFIC AMERICAN OFFICE 1859

What an age of wonders it has been! What a transformation has been wrought upon the face of the earth! Surely no tale of the Arabian Nights, no fantasy of Jules Verne depicts marvels so amazing as those which the Scientific American has been the first to describe authoritatively as soon as they appeared. Who would have thought, seventy years ago, that with the aid of the X-rays we could look through a man's body; that friend could talk with friend from New York to San Francisco; that Niagara Falls would illuminate cities; that street cars would move magically through our towns without any apparent means of propulsion; that pictures would be sent by wire from New York to Chicago, and that by means of the boundless ether a solitary passenger ship on a desolate ocean still keeps in touch with civilization.

It has been the privilege of the Editors of the Scientific American to know the men whose master minds have wrought these things, and to hear from their own lips the story of their struggles and their triumphs. Ericsson, Morse, Edison—the whole dynasty of inventive genius which has made the nation what it is—the editors have known them all.


Copyright by B. G. Mitchell.

THE SCIENTIFIC AMERICAN OFFICE 1915

Seventy years is a turning point not only in the life of man, but in the life of any enterprise. It seems fitting that the occasion should be commemorated by the publication of a number which will review the progress that the United States of America has made in the three-score years and ten ot our existence.

In June a number will appear which the Editors hope will do full justice to the great theme of American invention—a number which will transport us all back to the time when our fathers and our grandfathers still burned candles, when horses pulled street cars, when there were no automobiles and when the steam railway was a curiosity that people would travel miles to see. The motion picture machine of industrial progress will be turned backward, and the flickering film will make you wonder what the future will have in store if so much that is wonderful has happened in the past.

**MUNN & COMPANY, Inc., Woolworth Building, New York**


DAIMLER


McCORMICK


HENRY


MERGENTHALER


HOWE


PARSONS

# SCIENTIFIC AMERICAN

1845 — 70th Anniversary Number — 1915




Vol. CXII. No. 23
June 5, 1915

Munn & Co., Inc., Publishers
New York, N. Y.

Price 25 Cents
$3.00 A Year

# Hupmobile for Nineteen Sixteen
# $115 Lower in Price—$200 Greater in Value

## These two facts about the 1916 Hupmobile make this the most important announcement this company has ever made.

The 1916 Hupmobile is priced at $1085—$115 less than our 1915 model.

Yet we have gone to greater lengths than ever before to maintain the Hupmobile reputation for quality. The new Hupmobile has twenty per cent more power, giving a quicker pickup, an even stronger pull on hills and in sand, and slower running on high speed. We have made many refinements throughout the chassis; increasing the quality and improving the workmanship everywhere. Note these mechanical features: Tungsten steel valves, disc clutch with 16 hardened steel plates, bronze-shell motor bearings, spiral bevel gears in rear axle, nickel steel axle shafts, vanadium steel mainleaf in springs, tubular propeller shaft. Compare these features of the $1085 Hupmobile with any car on the market.

The 1916 Hupmobile maintains the reputation of earlier Hupmobiles for economy. The total repair expense of 54,000 Hupmobiles now in service, including breakages due to accidents, is less than one-quarter cent per mile. The 1916 Hupmobile will probably reduce this average. Though twenty per cent more powerful the 1916 car is a fit companion for our earlier models in gasoline mileage, tire service, and oil consumption.

We have been told countless times that the 1915 Hupmobile is the easiest riding car ever built. The 1916 Hupmobile is more comfortable. The upholstery is deeper. Genuine high grade hair and improved cushion construction give the comfort of an old shoe. Springs are even more flexible and easy riding. We have moved the control levers forward to add roominess, and changed their shape to give easiest operation. Tires are large in proportion to weight. The 119 inch wheelbase cradles you over bumps and smooths rough roads.

We know you will be charmed with the perfect performance and the luxurious ease of the 1916 Hupmobile.

The upholstery is genuine high grade leather. The open bodies are lined, with no highly polished surface exposed to scratches or mars. Floor-boards and clear running boards are best linoleum. The tonneau is richly carpeted.

The new bodies have a depth of color and luster of finish you have heretofore seen only in highest priced cars. Fenders, radiator, and motor bonnet are enameled by a new process—beautiful and long wearing.

The 1916 Hupmobile has the famous Bijur system for electric starting and lighting. This equipment is used on some of the highest priced cars. Latest improved battery ignition—surest and simplest built—is used. In our own shops we build the genuine Goldie one man top and Collins quick-acting curtains. Five demountable rims, complete electric lighting equipment, latest and best speedometer, an exclusive design rain vision and ventilating windshield, Hupmobile patented tail light, genuine crown fenders, non-skid tires on the rear wheels, are regular equipment on the 1916 cars. You will find nothing that makes for completeness missing from the Hupmobile.

These many improvements in style and refinements in design we give you in the 1916 Hupmobile at $1085 for the five-passenger touring car or roadster. You considered the 1915 car a big value at $1200. Compared with our previous cars the 1916 model is not only a bigger value but it is offered you at a reduction of $115.

We have accomplished these two results so important to you—first, by pledging ourselves to a fifty per cent increase in production for 1916, which means we buy better materials cheaper and greatly reduce overhead cost per car; second, by increasing our factory facilities and improving factory methods—new machinery and new processes enable us to build better at lower factory cost; third, we are confident that no car on the market is sold on a narrower margin of profit than the 1916 Hupmobile.

In a word, in our 1916 cars we are giving you the saving we effect through reduced factory costs, reduced material costs, and an unusually low profit per car.

For 1916, too, we offer you a complete line of Hupmobiles. We are now prepared to give you any type of car your needs or your tastes may demand—five-passenger Touring Car, two-passenger Roadster, All-Year Touring Car or Coupe, seven-passenger Touring Car, seven-passenger Limousine, five-passenger Sedan. We have absolute confidence that each of these types is the best value at the price on the market—certainly the best value ever built by this company.

All types retain the Hupmobile steady-riding, low-hung chassis; all bodies are racy and distinctive in appearance; all models are highest quality in every detail of construction.

In considering the 1916 Hupmobile please remember that the Hupp Motor Car Company is one of the few manufacturers in the United States that have never built a poor car or had an off year. Wherever you go you will hear the Hupmobile spoken of as a car of most unusual value at its price. That is why "we believe the Hupmobile to be the best car of its class in the world." That creed of ours is fact to Hupmobile owners.

The reputation of quality in our cars is the biggest asset of our business. And we guard it most jealously.

So when we tell you the 1916 Hupmobiles are the best cars this company has ever built, and when we offer you our best cars at a reduction in price, you may well take our word for it that you will make no mistake in selecting a Hupmobile.

But we don't ask you to accept our word alone. We do ask you to see the 1916 Hupmobile—to ride in it—to drive it if you will.

Write for your copy of our new catalog which illustrates and describes in detail all the 1916 cars.

And won't you please ask the Hupmobile dealer in your city to prove to you every statement we make in this advertisement. Let him show you in an actual merit test that the 1916 Hupmobile is just what we say—truly "the best car of its class in the world."

**1916 HUPMOBILE PRICES**

Five-Passenger Touring Car, $1085
Roadster, $1085 · Sedan, $1365 · Limousine, $2365
All-Year Touring Car, $1185 · All-Year Coupe, $1165
Seven-Passenger Touring Car, $1225

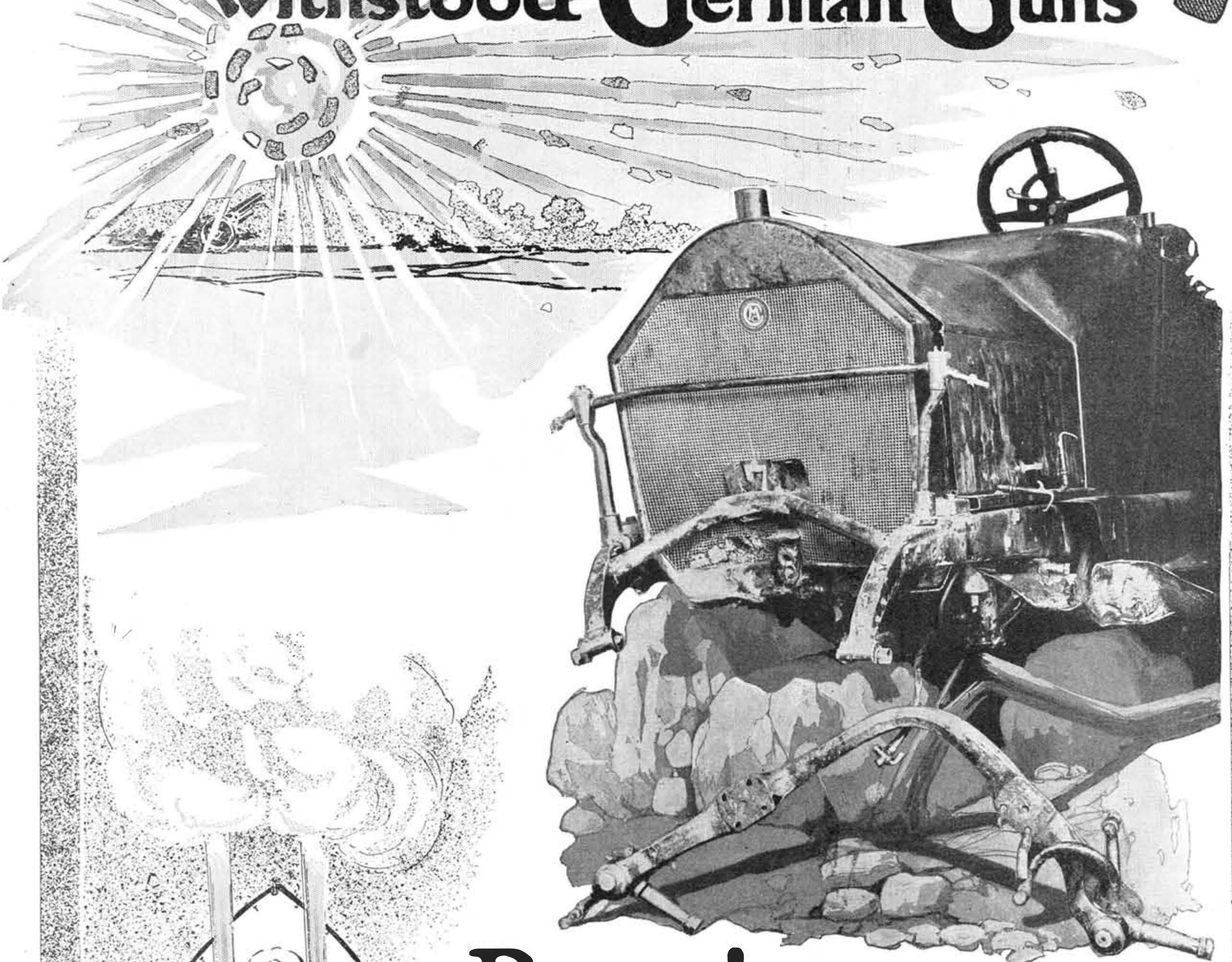
PLEASE MAIL THIS COUPON

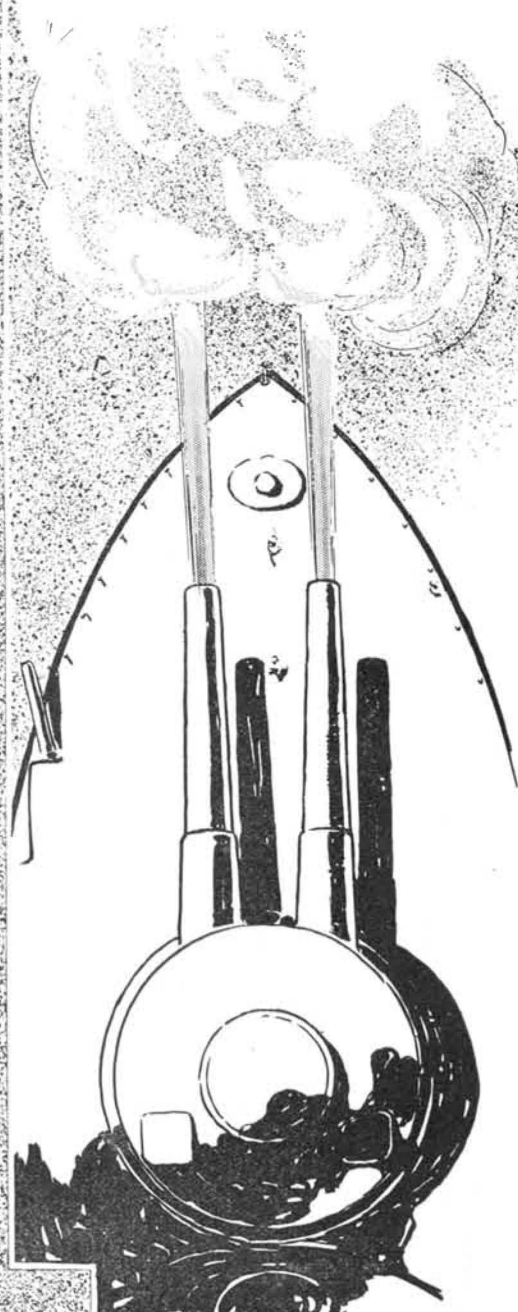
*Hupp Motor Car Company, Detroit, Michigan:*
*Send me your complete catalog of 1916 cars.*

*Name* ____________________

*Address* ____________ *City and State* ____________

HUPP MOTOR CAR COMPANY · DETROIT, MICHIGAN





### Soft Coal for Heating Practical and Economical

When consideration is given to the fact that for every one thousand cubic feet of contents of the average building, about $2.00 is spent per year for the coal burned in the heating apparatus, it is easy to realize what a large percent of the operating cost of any building goes to the coal bill.

It, therefore, is the best of business on the part of any owner or prospective builder of a large apartment, or other type building, to study very carefully the question of coal and its relation to the boiler in which it will be used. And it has been demonstrated very conclusively that the coal cost of a building is an item that may be reduced, in some cases as much as 40%, by the installation of a boiler permitting the use and adaptable to the use of coal of highest value — cost considered.

### Soft Coal Not Prohibited

Due probably to the fact that practically all cities of any size or importance are enforcing stringent ordinances against smoke, many people have a wrong impression that the use of soft coal is prohibited in certain cities. There is no ordinance, in any city, which says you must not burn soft coal. The furthest that any ordinance goes is to say that smoke will not be permitted and in such cases a type of boiler that will burn soft coal smokelessly is approved just as quickly for soft coal use as the ordinary type boiler for the use of anthracite or hard coal.

It is not a hardship to building owners for a city to enforce an ordinance prohibiting smoke. As a matter of real fact, legislations against smoke is an economy forced upon building owners.

Smoke is waste. It is sure proof that the boiler is not burning all of the fuel — and any ordinance, therefore, which prohibits smoke merely insists that building owners stop wasting fuel.

### What Engineers Say About Smoke

Here is what some heating engineers say about smoke: "If nearly perfect combustion has taken place in the firebox of a boiler we are able to obtain an efficiency as high as 75 percent; by which is meant that 75 percent of the actual heat in fuel is utilized. The other 25 percent is a loss that cannot be avoided as it represents loss resulting from radiation and gases escaping into the stack which are necessary to cause draft."

"Whenever dense smoke issues from a stack we can safely say that it represents much of the actual heat value in the fuel (as smoke is nothing but particles of carbon carried from the boiler in gases insufficiently heated to burn)."

"Therefore, Mr. Owner is losing a big percentage of what he could save if his boiler was a type that would turn these escaping gases into heat by burning them at high temperature."

### Soft Coal a Better Buy Than Anthracite

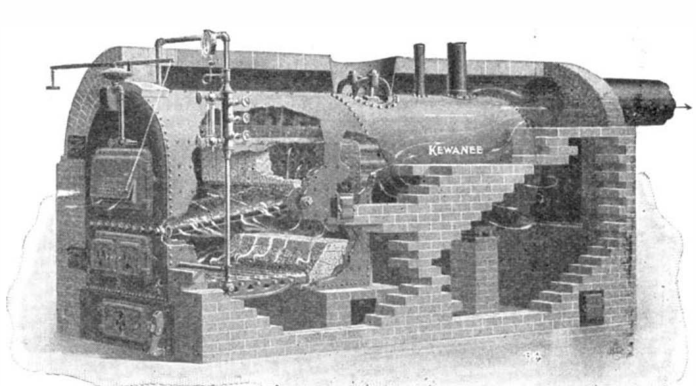
Dollar for dollar you get more heat by purchasing soft coal than when buying anthracite. The average run of mine soft coal, which costs in the neighborhood of $4.00 per ton, contains about 14,000 heat units per pound. In New York City (very close to hard coal mines) an anthracite coal, pea size, which contains about 12,000 heat units per pound costs about $4.40. That means that for about 40 cents less per ton you can get 2,000 heat units per pound more by buying soft coal. And in cities farther from the hard coal mines the difference is even more in favor of the purchase of soft coal.

There are two reasons, therefore, why a building owner should install a boiler which will burn soft coal smokelessly and these reasons apply whether his building is located in a city enforcing a smoke ordinance or not. First, soft coal costs less than anthracite. A given amount of money spent for soft coal buys more heat than the same money invested in anthracite. And when a boiler is installed that burns soft coal smokelessly it proves that it is wasting none of the fuel.

# Cut Coal Costs by Burning Soft Coal Smokelessly

It is a fact, thoroughly proven, in buildings of all types, in all parts of the country, that the installation of a boiler that will burn soft coal smokelessly will reduce coal bills.

A dollar spent for soft coal buys more heat than the same money spent for hard coal. Government reports show that the anthracite coal, ordinarily used in large buildings, contains an average of 12,000 heat units a pound. It costs about $4.40 a ton, while soft coal, which costs about $4.00 a ton, contains about 14,000 heat units a pound. So, buying soft coal you get *more heat for less money.*




*Sectional View Kewanee Smokeless Firebox Boiler (Brickset type) showing arrangement of double grate and long travel of gases.*

Kewanee Smokeless Firebox Boilers are built with two grates, one above the other. Fuel is fed onto the top grate and the draft, which is downward, draws the gases down through the fire on the upper grate and over the hot coals on the lower grate. This burns all the heat-giving gases before they can be condensed into smoke.

Built in sizes correctly proportioned to heat from 1600 to 15,000 square feet of steam radiation, or from 2,600 to 24,500 square feet of hot water radiation.

Furthermore, smoke is an indication of wasted fuel—so a boiler that can burn soft coal smokelessly proves that it is wasting none of the coal.

## KEWANEE
## Smokeless Boilers

are burning cheap soft coal in all kinds of buildings, and in all parts of the country, and are not making enough smoke to conflict with any smoke ordinance — no matter how rigid.

Kewanee Smokeless Boilers are not new, nor untried. On the contrary they are a combination of the firebox boiler and the down-draft grate construction known for years and approved by practically all engineers as the proper method of burning soft coal smokelessly and efficiently.

*Let us send you our booklet "Cutting Coal Costs." Also a list of buildings where Kewanee Smokeless Boilers are reducing fuel bills.*

### You Can Prevent Smoke

It is absolutely impossible to unscramble an egg, and it is just as impossible to burn smoke. The only remedy is to burn all of the elements that go to make smoke, and thus prevent smoke.

Chemistry teaches us that the result of complete combustion, or perfect burning of coal, is a colorless gas known as carbon-dioxide ($CO_2$). And an analysis of smoke shows that it is one part of carbon combined with one part of oxygen, or carbon monoxide (CO). In other words, one atom of carbon is capable of taking up two atoms of oxygen, and when this is accomplished the burning is complete. The black smoke which sails from some of the stacks is principally carbon monoxide — carbon which has taken up only one-half as much oxygen as it is capable of handling and from this atom of carbon, therefore, there has been only one-half of its full amount of heat produced.

### Burning Soft Coal Smokelessly and Economically

About five years ago there was placed on the market a type of boiler that accomplishes all of these requirements admirably. It consumes soft coal so perfectly that almost no smoke is visible at the chimney and at the same time shows a boiler efficiency averaging about 20 percent higher than the usual type of heating boiler. The boiler referred to consists of an adaptation of the well-known Hawley down-draft furnace principle to a firebox or portable steel boiler. It consists of an upper grate made of heavy steel water tubes, built into the furnace and extending from the inside head-sheet to a cross header running from one side-sheet to the other. Below this is a lower grate of the usual rocking pattern that burns such half-consumed fuel as falls through from the upper grate.

In the operation of this type of boiler all of the coal is fired onto the water grate, and through this upper fire-door the greater part of the air is admitted, forming a draught down through the green coal and carrying the heat-giving gases down through the live fire and into the large combustion chamber where it is entirely consumed by the heat of the lower fire which is fed by the coked live coals which fall between the wide openings of the water grate. The combustion chamber back of the upper grate is large and high, giving the smoke a low velocity and ample time for perfect ignition before coming in contact with the cooler boiler plate.

The type of boiler referred to above has proven two things conclusively. First, that it can burn soft coal smokelessly and in conformity with any smoke ordinance ever passed, no matter how stringent. And it has also proven its ability to reduce fuel bills.

This is true not only in the west where anthracite or smokeless coals are hard to obtain and very high priced, but also in the eastern markets where hard coal is cheapest. Even in such cities as Pittsburgh, Philadelphia, New York, Baltimore and Washington, right in the heart of the hard coal region, this type of boiler, burning soft coal, has proven that it can supply heat cheaper than the ordinary type of boiler burning hard coal.

## KEWANEE BOILER COMPANY

Kewanee, Illinois

CHICAGO NEW YORK ST. LOUIS KANSAS CITY MINNEAPOLIS

Pioneers in the Manufacture of Steel Firebox Boilers for the Smokeless Burning of Soft Coal

SEVENTY-FIRST YEAR

# SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

VOLUME CXII. NUMBER 23. | NEW YORK, JUNE 5, 1915 | 25 CENTS A COPY $3.00 A YEAR

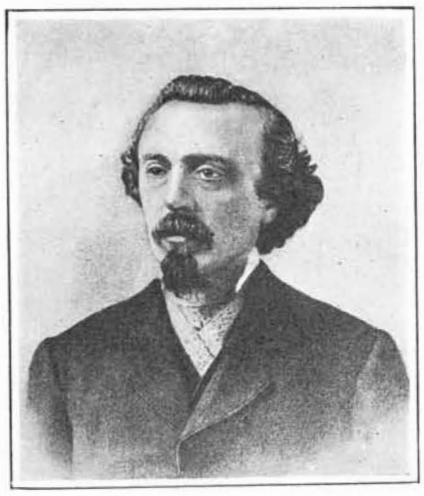

Gordon McKay, inventor of the McKay shoe-making machines.

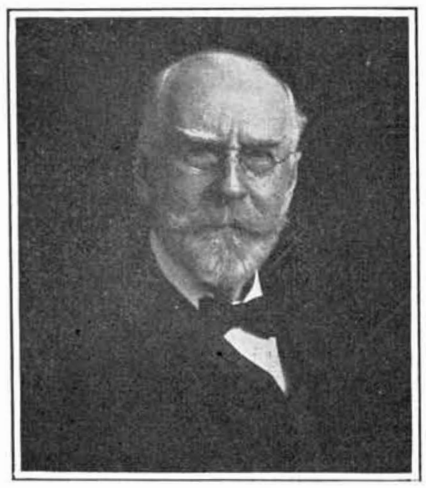

Isaac Singer, inventor of the Singer sewing machine.

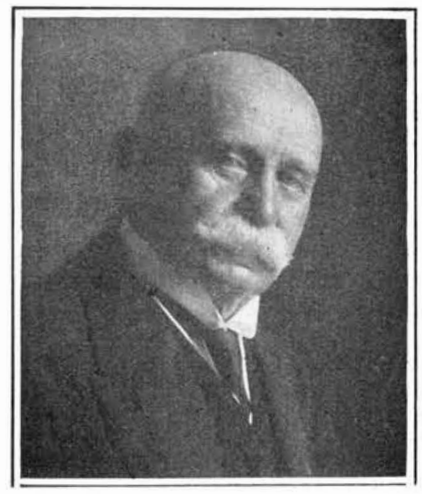

Lyman E. Blake, inventor of shoe-making machinery.

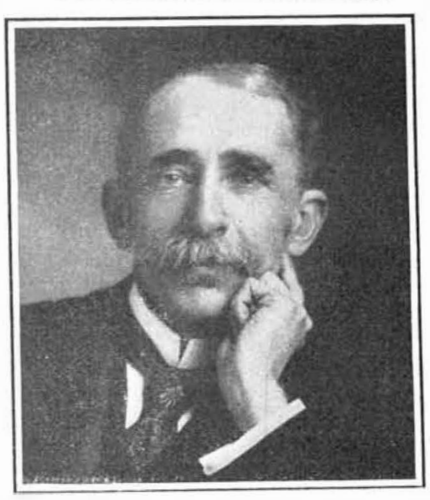

Charles Goodyear, inventor of the Goodyear lasting machinery.


Joseph Henry, who laid the foundation of the electric telegraph.

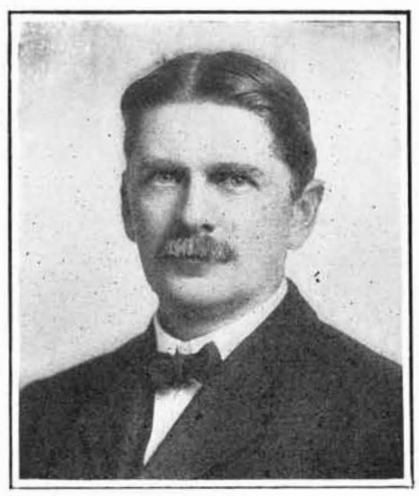

Charles J. Vandepoele, inventor of American overhead trolley system.

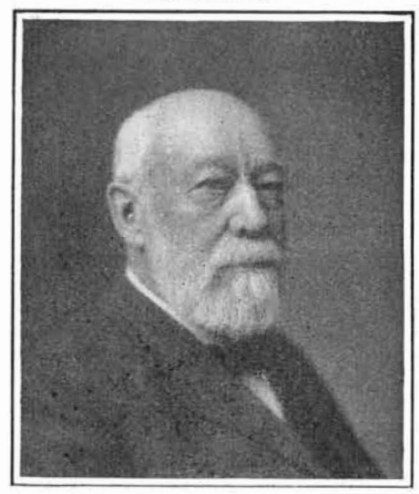

Dr. Coleman Sellers, pioneer motion picture and machine tool inventor.


Count von Zeppelin, inventor of the rigid airship.


Prof. J. A. Fleming, inventor of the electric valve used in wireless.


James Gayley, inventor of the dry-blast process of steel making.


Charles E. Scribner, inventor of telephone switchboards.


J. S. Hyatt, an industrial chemist, who discovered celluloid.


Frank Sprague, inventor of the multiple unit system of train control.


Charles G. Curtis, inventor of the Curtis steam turbine.


Copyright by Edwin Levick

Dr. Rudolf Diesel, inventor of the Diesel engine.


Charles P. Steinmetz, inventor of the magnetite arc.

SOME GREAT INVENTORS OF THE PAST SEVEN DECADES

# SCIENTIFIC AMERICAN

**Founded 1845**

**NEW YORK, SATURDAY, JUNE 5, 1915**

Published by Munn & Co., Incorporated. Charles Allen Munn, President; Frederick Converse Beach, Secretary; Orson D. Munn, Treasurer; all at 233 Broadway, New York.

Entered at the Post Office of New York, N. Y., as Second Class Matter
Entered as Second Class Matter at the Post Office Department, Canada.
Trade Mark Registered in the United States Patent Office





**Subscription Rates**

| | |
|---|---|
| Subscription one year | $3.00 |
| Postage prepaid in United States and possessions, Mexico, Cuba, and Panama. | |
| Subscriptions for Foreign Countries, one year, postage prepaid, | 4.50 |
| Subscriptions for Canada, one year, postage prepaid | 3.75 |

**The Scientific American Publications**

| | | |
|---|---|---|
| Scientific American (established 1845) | per year | $3.00 |
| Scientific American Supplement (established 1876) | " " | 5.00 |
| American Homes and Gardens | " " | 3.00 |

The combined subscription rates and rates to foreign countries including Canada, will be furnished upon application.

Remit by postal or express money order, bank draft or check.

**Munn & Co., Inc., 233 Broadway, New York**

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp* the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

*The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.*


## Our Seventieth Anniversary

NOW that the SCIENTIFIC AMERICAN has reached the seventieth year of its existence, it seems fitting that we should pause and survey the progress that has been made by the world during that period. To do that most effectively one must transport one's self back seventy years—strip one's self of by far the greater part of the mechanism which we have come to accept as a matter of course. It has been said that the civilization and culture of Egypt, of Mesopotamia, five thousand years ago, was superior to that of London, Paris, or Rome one hundred years ago. Take away all the material advantages which have been given to us by science and invention and we drop back to a period where we have still not learned how to control matter and force.

When the SCIENTIFIC AMERICAN was established we had only Davy's arc and electrolysis, Oersted and Ampere's revelations in electrodynamics, Daguerre's photography, Henry and Faraday's work in induction, and Joule's mechanical equivalent of heat. The telegraph and the reaper had just been born. There was no telephone, no motion picture machine, no oil refining industry, no electric incandescent lamp, no wireless telegraph, no flying machine or airship, no typewriter, no automobile, no electric railway, no Bessemer steel, no phonograph, no passenger elevator, no steam turbine. Why continue the list any further? Much of the transformation which has marked the last seventy years has taken place within the lives of men still with us. The amazing rapidity with which industries have grown and conveniences multiplied may be attributed to the very nature of invention and research. Hardly was one discovery made when a vista to a whole series of new discoveries is opened, and each of these in turn disclosed bypaths to still newer fields. So development has progressed with the rapidity of wildfire.

And yet science and invention are young. Because they are, the SCIENTIFIC AMERICAN must remain perennially youthful.

What a period of scientific activity we have lived through! And yet all that we have witnessed is but a mere episode in the evolution that still lies before us. What discoveries and inventions we have still to see and record! When we think that at the time the SCIENTIFIC AMERICAN was started it took three weeks to send a message from New York to Liverpool and three months to Calcutta, when we think that only yesterday we marveled at the application of ether and chloroform to surgery, at the feat of telegraphing across the ocean without wires, at the bigness of the Panama Canal, at the opportunity of viewing the skeleton beneath the living flesh with the X-rays, and the spectacle of a man flying in the air swifter than any bird; when we think that it has been our privilege not merely to see these and many other miracles and to translate them into print, so that the wonder of them and the beauty of them might strike all men, who can blame us if we contemplate our future task with a feeling almost akin to awe? We have marveled at the discovery of radium and the breaking of the atom into corpuscles; at the tracing of diseases to the multiplication of infinitely small living things. Yet if we compare ourselves with those who will record the achievements of science a century hence, we in this day may seem to have progressed but little beyond the stage when the moon and the stars were to mankind but lanterns hung on a great tent wall and not separate worlds in infinite space.

## The Greatest Ten Years of Invention

THE most significant event in the annals of human achievement was the invention of the steam engine. Its introduction divided recorded time into two distinctly defined eras, and it may well be said that the entire history of man's material endeavors counts forward or backward from that comparatively recent event. The jump from manual to power operations, which typifies the two eras, was nothing short of cataclysmic, and profoundly affected and stirred mankind in all its relations to an extent inconceivably greater than any political change or decision in battle that is ordinarily cited by the historian to mark the beginning of a new epoch.

As soon after this event as distracted civilization could be released from the stifling bondage of incessant warfare, the problem of applying this mighty agency to the needs of man began in earnest—with an energy, capacity, and genius never ceasing and never before equaled. Thus was inaugurated the age of machinery, of invention, of industrialism—an age vitally different from all that preceded it and during which the basis of society was more completely altered and the economic and political structure more fundamentally revolutionized than in all the preceding centuries of civilization put together.

Of the ten decades which may be roughly stated to cover this notable period of development, not one has failed to contribute its quota toward the sum of great inventive achievements. Each and every decade has seen the origin of some transcendent act for the advancement of material civilization.

The ten years most fraught with achievement up to the invention of the telephone, was the 1840-1850 period, during which the reaper, vulcanization of rubber, sewing machine, and telegraph were perfected. These inventions, by far the most notable of the decade, were all American and marked the culmination of Yankee ingenuity, and it is safe to assert that no other people in any equal short span of time can point to a record of accomplishments so marvelous and so revolutionizing, industrially and socially.

The decade beginning with 1870 was also notable—the telephone, the dynamo, and the arc lamp appeared and gave the first indications of the coming part electricity was to play in the affairs of mankind.

But the ten years beginning with 1880 saw an outburst of inventive activity that dwarfed all similar periods in the history of invention. It seemed that the discoveries in things electrical in the last three or four years of the previous decade was the signal for the pent-up genius of the world to let loose.

The trolley car, which has changed the face of urban civilization; the incandescent light with its more powerful and healthier glow and more adaptable use; the automobile, the most distinctive feature of our time; the typewriter, the most necessitous instrument in modern business; the skyscraper, the delineator of the new skyline of American business centers; and the cash-register, that ubiquitous instrument and first aid to honesty—to pick out the most obvious of the innovations that proclaim the age—all of these came into being or were first whipped into shape in the ten pregnant years beginning with 1880.

Before 1880 electricity was sparingly used—the first central station for arc lighting had just been established in 1879. Its recognition as a source of energy for universal lighting, for propulsion, for power, and for heating—for all the large and vital uses it could be put to—was a matter of speculation, and not one of expectedly near realization. No one, even of the wildest imaginings, could have dreamed of the transformation so close to hand. But before this census period closed the electric incandescent lamp was incontestably established, the trolley car was successfully introduced, the central station for power distribution and the polyphase motor for stationary work began to show its revolutionizing possibilities, and the first electric furnace was put into successful commercial operation.

All the big problems that were involved in putting into service in such large ways of this new and mighty servant were first confronted and solved in this particular decade. In the 80's the generation, transmission, and utilization of current—the dynamo, the transformer, and motor—were all made practical propositions on a large and commercial scale for the first time. The trolley car, which drastically changed the aspects of things urban and suburban, brought the country to the city and spilled the city into the country, increased land values by the billions; and the incandescent lamp, which inaugurated clean and safe illumination, introduced the central station power house and inspired the first great innovations in generation and utilization of electric current; the transformer, that extremely simple but supreme instrument for making serviceable the alternating current—the most easily generated and transmittable form of electrical energy; and the induction motor, the eventual driver of most of our machinery—all these peaks in electrical progress were made in the same decade.

The most fundamental of all operations are performed in the furnace. The profoundest changes of nature were caused by heat and the basic processes of industry are carried under high temperature conditions. Except a new source of energy, it is difficult to conceive a new utility of more potency than a novel type of furnace. For the first time in all history, a high furnace heat was attained through means not involving combustion, when the electric furnace was perfected in the latter part of the decade. With the advent of this utility, possibilities of heat application were opened up that shamed even the dreams of alchemy. There is no burning, no smoke or foul gases—resultants of combustion. The heat is clean, controllable, and extremely high, with the result that it is revolutionizing high temperature operations in multitudinous directions, and the changes in steel and alloy making and in electro-chemical processes are already profound.

The steam turbine, which is supplanting the reciprocating engine; the gasoline engine, which made possible the motorboat, automobile and aeroplane; the automobile itself; the Mergenthaler typesetter and caster; the cyanide process, which vies in importance with the Bessemer method of making steel and the vulcanization of rubber; and electric welding—all of these truly epoch-making inventions first saw the light of day in this census period.

The Harvey process for hardening armor plate was invented in 1888; smokeless powder a few years earlier; the wax phonographic record, which made the phonograph a practical proposition, came out about the same time; Westinghouse's quick-acting brake, which only failed to be considered a pioneer invention of the first order by a five to four vote of the Supreme Court, was another notable addition to the decade; the transparent film, which foreshadowed the moving picture; and the pneumatic tire, which helped to popularize the bicycle and automobile, were prominent contributions of these pregnant ten years.

The half-tone process, the most notable advance in the reproductive arts since lithography was established; the Janney type car-coupler, the greatest life-saver ever invented; and the centrifugal creamer, which has saved the farmers of the civilized world hundreds of millions of dollars, were all commercially established during this period.

## The Super-battle-cruiser

THAT the leading naval power in the world is satisfied that the battle-cruiser has fully vindicated the claims of those who were responsible for its introduction, is proved by the fact that the British Admiralty is completing four ships of this type in which the elements of speed and gun-fire will be carried such a great step in advance as to place the new ships in a class by themselves. Indeed, if there be such a vessel as a super-dreadnought, it is certain that these ships should be termed super-battle-cruisers.

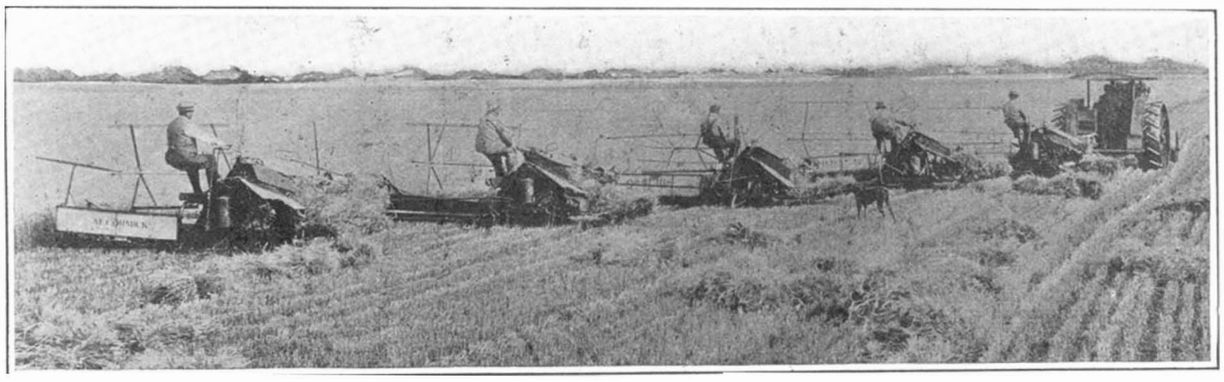
We are reliably informed that this group of ships is being rushed to completion, and that the extreme features which they will embody in the way of gun-fire and high speed were decided upon as the result of experience gained during the present war. They are to mount the 15-inch gun, and they are designed to steam at a sustained sea speed of 32 knots. The armor protection is to be of moderate thickness, necessarily. Now here we have a ship which will have the widest possible range of usefulness outside of the line-of-battle engagement between heavily armored dreadnoughts. Thus, if the German battle-cruisers should attempt another raid on the English coast, the 32-knot ships, if they get in touch, could easily overtake and sink them. They could catch and sink the fastest of the modern scouts; and in any but the calmest weather could round up and dispose of a whole fleet of torpedo boat destroyers, whatever their speed might be. Also, if their own fleet were pursuing a battleship column, they could overtake and concentrate on the rearmost ships, thereby forcing the enemy to accept engagement—unless, indeed, the enemy admiral should leave his rear to shift for itself, as was done by the German battle-cruisers when they left the "Bluecher" to its fate in the North Sea battle.

The persistent cutting down by Congress of the programmes of battleship construction submitted by our Navy General Board, is responsible for the fact that to-day the United States Navy does not include a single ship of the battle-cruiser type. If we possessed the battleship strength which the General Board considers necessary for the safety of the country, they would recommend the creation of a battle-cruiser fleet—indeed, we should now have several of these most necessary ships under construction.

# Seventy Years of Invention

## A Record of Progress, Decade by Decade

The old cradle.

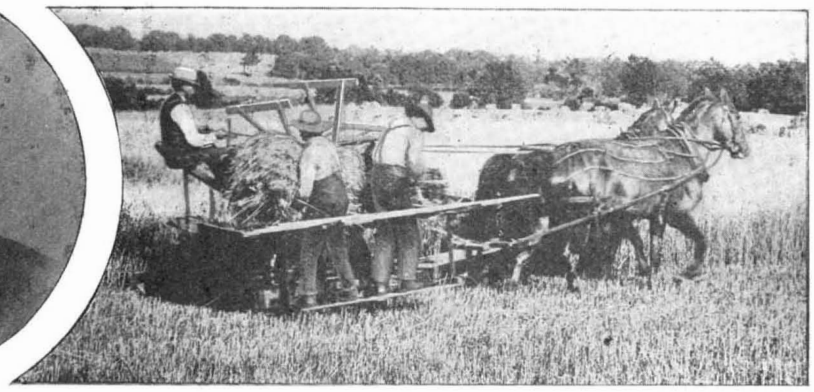


The modern way of harvesting with tractor power.

Used for forty centuries.

The first McCormick self-rake reaper.

Cyrus H. McCormick.



The Marsh harvester.

*In this article we have endeavored to record the principal inventions which during the last seventy years have contributed markedly to industrial progress. The record is necessarily incomplete; for in the limited space at our disposal, we could not do more than indicate the most important achievements. We have confined ourselves almost entirely to mechanical inventions, not that the work done in industrial chemistry and pure science falls without the scope of the* SCIENTIFIC AMERICAN, *but simply because the* SCIENTIFIC AMERICAN *has been very closely identified with invention.*

*In order to avoid unnecessary duplication, the facts recorded in special articles appearing elsewhere in this issue have not always been incorporated in the following. But the leading achievements in the main arts have been repeated wherever it seemed desirable to keep the record as complete as possible. Very few references have been made to military inventions. It was felt that this should be a record of industry and peace.*

*We wish here to acknowledge the great assistance which has been given to us by many of the leading manufacturing firms, inventors, and engineers throughout the country. Without their generous help it would have been difficult, if not impossible, to reveal the beginnings of many an important industry.*—EDITOR.

### 1845-1855

TELEGRAPHY was the only practical application of electricity in the early 40's and, for that matter, for several decades following. Hardly had Morse's experimental line between Washington and Baltimore been successfully opened (1844) when literally dozens of inventors on both sides of the Atlantic applied themselves to the improvement of telegraphic communication. The article on communication appearing elsewhere in this issue reviews the art with such fullness that it need not be dwelt upon here.

#### Some Early Electrical Devices.

But, although the telegraph was the great electrical invention of the decade, experimenters were seeking to find new applications for electricity. Thus, in 1848 Foucault and DuBoscq constructed the first practical arc lamp, having a clockwork to adjust the distance between the carbon electrodes automatically. Charles Wheatstone and W. F. Cooke (1845) substituted electromagnets for permanent magnets in electromagnetic machines and thus brought electrical engineering nearer the modern dynamo.

There were even thoughts of the electric railway; for in 1851 the versatile and daring Moses G. Farmer of Newport made rather unsuccessful experiments with an electric railway, in which the current, derived from a battery, was sent through the rails. In 1851 Thomas Hall of Boston succeeded in driving a vehicle with a magnetic machine supplied from a stationary battery, an early attempt at electric automobiling. In 1854 M. Davidson also made experiments with an electric automobile.

Although Sir Humphry Davy had used the electric arc for the production of sodium, the modern electric furnace really begins with César Mansuète Despretz, who in 1849 conceived the idea of employing a carbon retort, the negative pole of the arc consisting of a carbon rod and the retort itself constituting the positive pole.

#### Progress in Automatic Machines.

Of far more importance, however, were the advances in mechanical invention. The idea of rolling window or mirror glass was proposed by Henry Bessemer. He poured the glass between two spaced hollow rollers cooled by circulating water. Picard and P. Simon revived the idea in 1887 and 1888. In 1846 Farthing endeavored to substitute compressed air for lungs in glass blowing. His method of glass blowing was much used by the end of the 70's.

In 1846 Richard Marsh Hoe made valuable contributions to printing machinery. He developed the type revolving press of the period, in which a single form of type was carried beneath four, six, eight, or ten printing cylinders and used to print upon a sheet borne by each. This press became the standard of the world. Later Stephen Tucker, an employee of Hoe's, converted this into the perfecting press; that is, into one that printed on both sides of the sheet. Eventually he adapted his machine to print upon a web or endless sheet of paper.

#### An Early Dirigible Airship.

The modern dirigible had its origin in this decade, for Henry Giffard built a cigar-shaped dirigible airship in 1852. It had a steam-driven propeller and actually traveled against the wind. In 1855 Giffard built a larger ship (4,500 cubic meters capacity).

Of the improvements in civil engineering that deserve to be noted, it must be mentioned that in 1846 the French engineer Fauvelle invented the process of boring with a continuous stream of water and succeeded in boring a 170-meter hole in twenty-three days, by forcing water under high pressure into a hollow boring tool. His process is the basis of the boring pump devised in 1860 by Chanoit and Catelineau.

In 1852 Merriweather, a California gold miner, invented the hydraulic system of mining gold.

The modern bicycle sems to have had its origin in 1854. P. H. Fischer, a mechanic of Schweinfurt, Germany, added pedal cranks to the velocipede. Quite independently Ernest Michaux hit upon the same idea in 1855. Rubber tires seem to have been first used in 1865 by M. Thévanon of Lyons.

#### Improvements in Steam Engineering.

In steam engineering the most notable achievement was undoubtedly George H. Corliss's invention, in 1848, of his famous valve gear, patented in 1849.

The first steam boiler with horizontal iron tubes was constructed in 1855 by Julien Belleville. Wilcox built his first steam water-tube boiler with inclined water tubes in the same year, his construction being later very much improved by Babcock & Wilcox.

In the year 1840 Henry R. Worthington conceived the idea of applying steam to the propulsion of canal boats. Among other difficulties encountered was that of supplying his boiler with water, while the boat was passing through the locks, the engine, and consequently its attached pump (the only type in use at that period), being at rest. The result of his investigations was the first independent single direct-action boiler steam pump ever constructed. This pump was in successful operation for over thirty years. Worthington began the manufacture of these pumps in 1845.

In this decade belongs the beginning of the modern high explosive industry; for in 1845 Christian Friedrich Schoenbein discovered nitrocellulose or guncotton.

#### The Bessemer Process Invented.

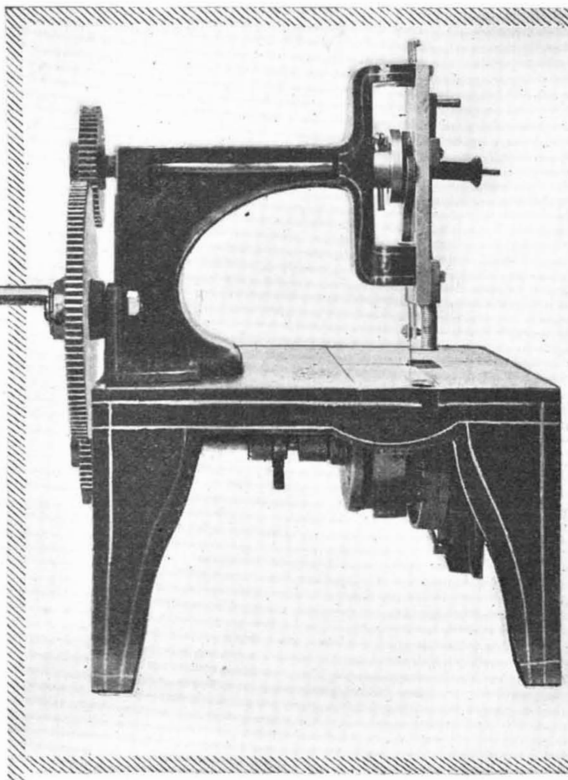
Industrially, by far the most important invention of the decade was the Bessemer process of making steel. It was in 1855 that Henry Bessemer invented his famous process for the direct conversion of molten cast iron into steel by blowing air into the molten mass. As a result the steel and iron industry was liberated from the dominance of hand labor, and the process of making steel was at once shortened from one and one half days to twenty minutes.

#### The Men Who Invented the Sewing Machine.

On September 10, 1846, Elias Howe received a patent for his epoch-making sewing machine. The features that made Howe's machine a success were a needle with the eye at the point, a shuttle operating beneath the cloth to form the lock sitch, and an automatic feed.

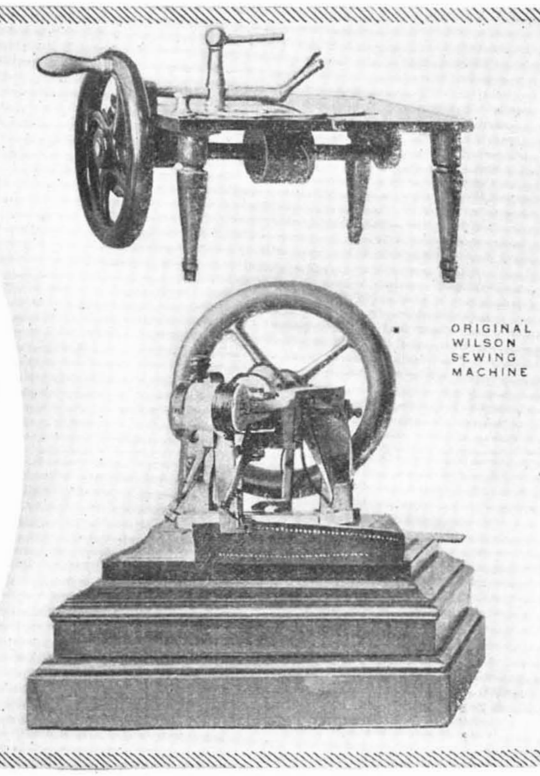
Next to Howe, the name of Allen B. Wilson claims notice as the inventor who has done the most to give us the present perfected sewing machine. To him we are indebted for those two most ingenious and beautiful pieces of mechanism; the rotating hook and the four-motion feed. He claimed to have conceived the idea of a sewing machine in 1847. His first machine was built during the spring of 1849, while he was employed in Pittsfield, Mass., as a cabinet maker. In the same year he built a second and better machine, and "up to this time," he says, "I had never seen or heard of a sewing machine other than my own." He took out his first patent on November 12th, 1850. This machine Allen B. Wilson brought to New York in order that he could exhibit it to the Editor of the SCIENTIFIC AMERICAN and have it described in that publication.

In 1851 Wilson patented his famous rotating hook, which performs the functions of a shuttle by seizing the upper thread and throwing its loop over a circular bobbin containing the under thread. This simplified the construction of the machine by getting rid of the reciprocating motion of the ordinary shuttle, and contributed to make a light and silent running machine, eminently adapted to domestic use.



The original Singer sewing machine.

Howe.




The original Howe sewing machine.

In 1852 Mr. Wilson patented his four-motion feed, which, in combination with a spring presser foot, may be said to form the basis of all modern feeding mechanisms.

In 1851 W. O. Grover and W. E. Baker patented a machine which made the "Grover & Baker chain stitch."

In 1859 Gibbs, a Virginia farmer, saw in the SCIENTIFIC AMERICAN a picture of a sewing machine. The working of the apparatus was very plain down to the moment when the needle perforates the cloth, and he fell into the habit of musing upon the course of events after the point of the needle was lost to view. The result of his cogitations, aided by infinite whittling, was the ingenious little revolving hook, which constitutes the peculiarity of the Willcox & Gibbs machine.

Patent No. 8294, of August 12th, 1851, introduced one of the most useful machines. Isaac Merritt Singer, strolling player, theater manager, inventor, and millionaire, brought into the business a new machine and novel methods of exploitation, which gave a powerful impulse to the youthful industry. The Singer improvements met the demand of the tailoring and leather industries for a heavier and more powerful machine. The novelties consisted in the circular feed wheel below the cloth plate, which had a serrated periphery projecting slightly above the plate, and was fed by a rock shaft and pawl; a thread controller; and the use of gear wheels and shafting to transmit the power from the hand wheel to the two countershafts for working the vertical needle and the shuttle. Singer was also the first to introduce foot power in place of the hand-driven crank wheel.

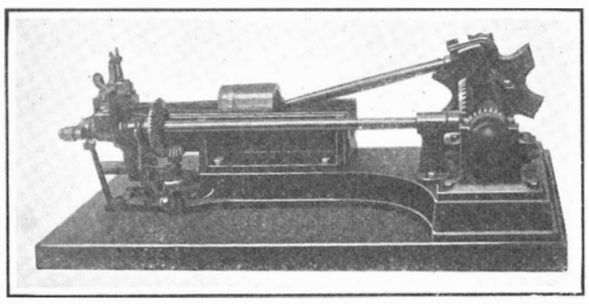
John Brooks Nichols, a Lynn shoemaker, about the year 1851 adapted the Howe sewing machine to sew the uppers of shoes, the first important step in the application of machinery to shoemaking. The first machine was introduced in Lynn in 1852 by John Wooldredge.

### The Passenger Elevator.

The first elevators were undoubtedly devised for the handling of heavy goods, and although the solid platform, hoisted by a hand-power windlass, was a great improvement over the original block and fall of the sailor, it was not intended that these mechanisms should be used to carry human beings. When, however, steam power had come into common use, and buildings had become taller, it was but natural not only that power should be applied to the operation of elevators, but that the extension of the use of elevators to the carrying of passengers should be suggested by the improvement. All of these changes were extremely gradual, the first power elevators being used indiscriminately for both freight and passengers; but it may be said that the first power elevator was installed in 1852, by Elisha Graves Otis; and a few years later he exhibited at the Crystal Palace, in New York, the first elevator with a safety device to prevent the car from falling when the cable broke. The first exclusive passenger elevator operated by steam was installed in the Fifth Avenue Hotel in 1859 by Otis Tufts.

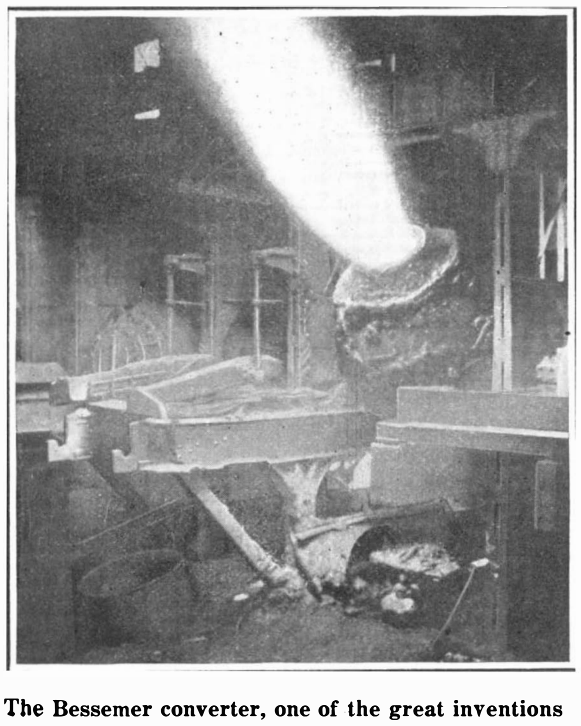
### The Beginning of the Typewriter.

Many acute minds were working before the first writing machine appeared. The efforts of inventors to produce a telegraphic printing machine gave impetus to the idea of a writing machine, although the first attempt to produce a typewriter is found in the records of the British Patent Office as far back as 1714. A really competent complete machine did not appear until 1843, when Charles Thurber of Worcester, Mass., patented a slow typewriter. The model was interesting as effecting the letter spacing by longitudinal motion of a platen—a principle which is a feature of all modern machines. Fairbanks in 1848 designed a machine for printing colors on cloth. It was impracticable.



**Model of the Otto gas engine in the National Museum, Washington, D. C.**

In 1847 Dr. Francis, a wealthy physician of New York, patented a typewriter, in which a motion similar to that of a piano hammer was employed to throw up the types, which were arranged in a circle to a common center. It was bulky and intricate, and although capable of good work was too costly for a commercial venture. This machine contained many of the salient features of the typewriter of to-day, such as the carriage traveling from side to side over the type basket, a large bell to indicate the end of the line, blank key for spaces.



**The Bessemer converter, one of the great inventions of the nineteenth century.**

### The Reaper and the Harvester.

In 1831, Cyrus H. McCormick of Virginia built the first practical grain harvesting machine. But it was not until 1845, the year in which the SCIENTIFIC AMERICAN was established, that the reaper was really introduced. It contained the essential elements that have been found in every grain harvester that has proved a success from that day to this. The first machine had a main wheel frame, from which projected to the side a platform containing a cutter bar, having fingers through which reciprocated a knife driven by a crank; upon the outer end of the platform was a divider projecting ahead of the platform to separate the grain to be cut from that to be left standing; a reel was positioned above the platform to hold the grain against the reciprocating knife, and to throw it back upon the platform, and the machine was drawn by a team walking at the side of the grain. The motive power was oxen or horses, hitched either at the side and front, or behind, and the grain, forced to the sickle by the reel, was cut and dropped to the platform. A man, walking alongside of the platform, removed the grain with a rake.

The great difficulty encountered by the predecessors of McCormick was the sickle. Many different devices were tried, but nothing equaled the reciprocating knife. The next improvement on the first practical reaper was McCormick's addition of a seat for the man who raked the grain. Several years later a self-rake was added, which eliminated the extra man. The reaper to-day is built largely along these lines.

The next progressive step in the development of the reaping machine was the application of an automatic mechanism to rake the grain from the platform to the ground. This work had, up to this time, been done by a man riding on the machine. In 1849 Jacob J. and Henry F. Mann of Indiana patented a machine having a series of endless bands for carrying the grain, after it had been cut and reeled upon these bands, to the side of the machine, where it accumulated in a receptacle until a sufficient amount had been gathered to form a bundle, when the operator dumped the receptacle, leaving the gavel upon the ground.

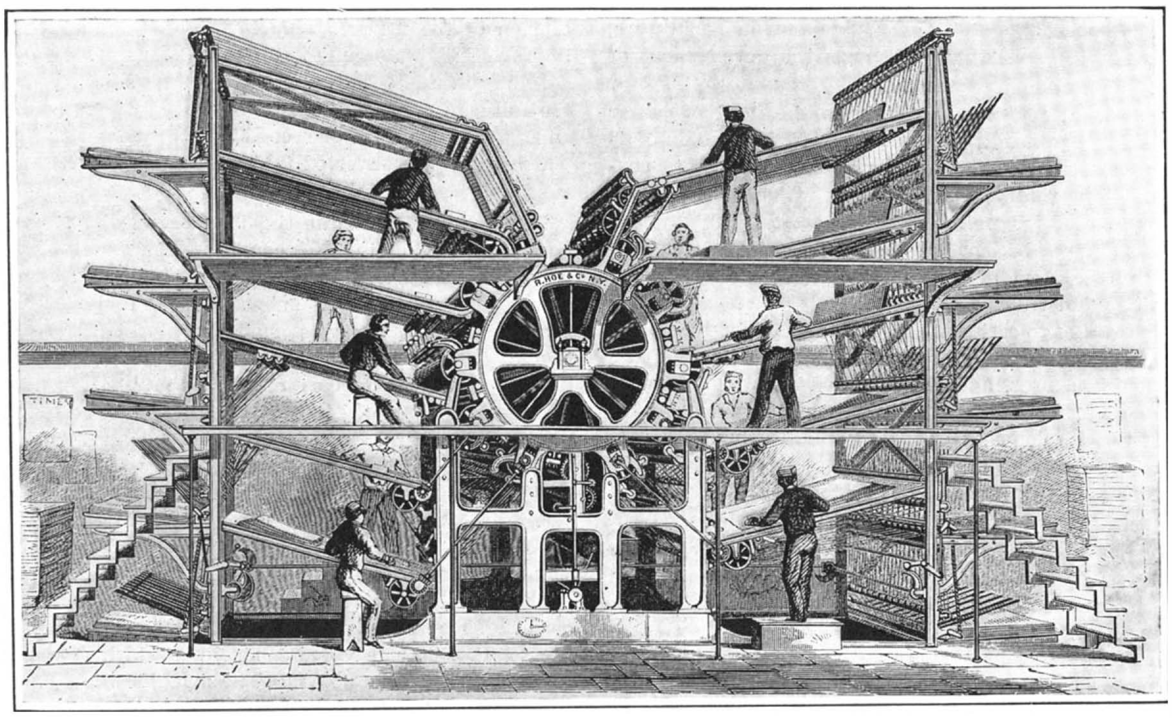
In 1850 Homer Atkins of Illinois invented a device for giving a reciprocating, intermittent motion to a rake, in order to deposit the grain upon the ground, after it had been cut and reeled upon the platform. This machine marks the beginning of an era of self-raking reapers, that continued to be supplied to the market for twenty years. In the summer of 1850, Augustus Adams and J. T. Gifford, of Elgin, Ill., built probably the first hand binding harvesting machine. It was a machine of the same type as the Mann machine of 1849, but it had in place of the receptacle into which the cut grain fell as it left the traveling apron that conveyed it to the side, a platform upon which men were carried through the field, and upon which the grain fell from the endless apron, where it was bound by men carried upon the machine. This is probably the earliest example of a machine which afterward came into extended use under the name of haul binding harvester.

In 1858 C. W. and W. W. Marsh of Illinois invented their harvester. The grain after it had been cut and

deposited upon an endless apron was carried to one side of the machine to men riding upon the machine, who bound this grain into bundles. It should be remembered that the self-raking reaper was the machine in general use up to this time, and men did the binding, walking from gavel to gavel. The Marsh machine is interesting not only as marking a progressive step in the development of harvesting machines, but as furnishing the machine to which the automatic binder was successfully attached.

The commercial value of all the branches of industry that owe their existence and prosperity to McCormick's invention of the reaper is beyond conjecture. The value of farms has increased from one million dollars in 1800 to twenty billions in 1906—more than four times the value of all the manufacturing enterprises in this country.

The yield of the crops is so enormous that not enough men could be gotten into the fields to harvest them if the reaping hook were the harvester.

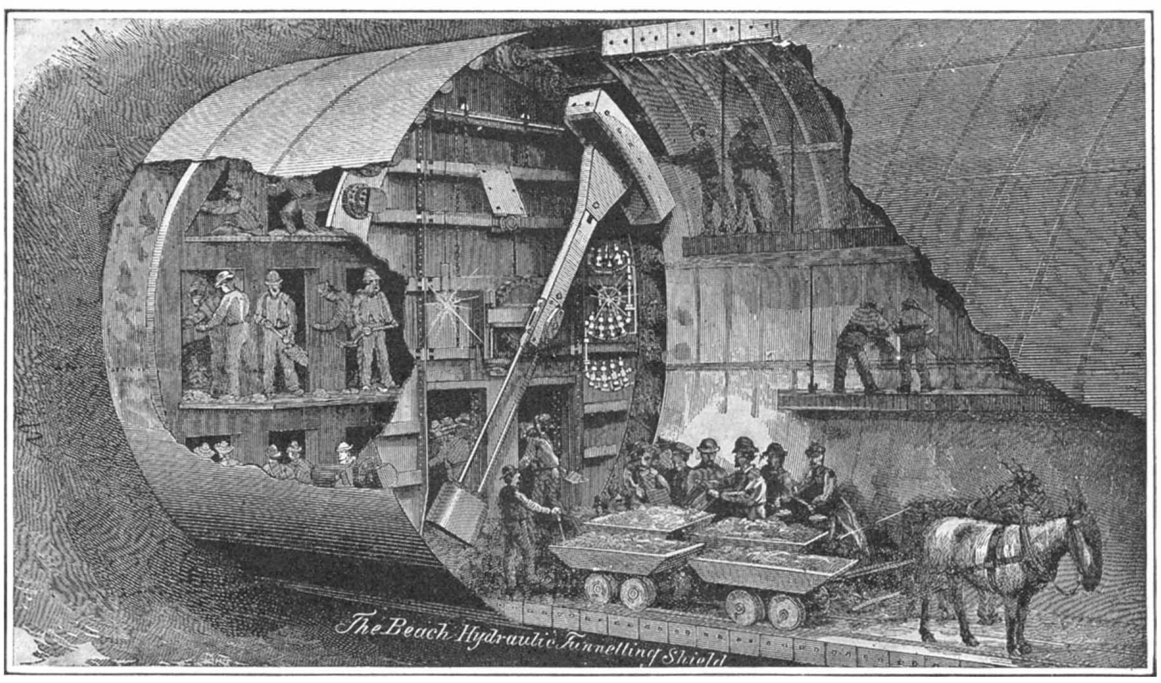


The Hoe revolving press of the fifties. From a contemporary engraving.

## 1855-1865

The decade is notable for the important work done in laying the foundation of modern electrical engineering.

The first direct current motor was built in 1860 by the Italian physicist Antonio Pacinotti. His machine consisted broadly of an iron ring, suitably wound, which rotated between the poles of a horseshoe electromagnet supplied with current from a battery. In the same year Pacinotti invented the commutator. Pacinotti did nothing with his inventions, important as they were. The world had to wait for Gramme to reinvent them.




Alfred E. Beach's hydraulic shield, first practically used in tunneling under New York, 1869.

Gaston Planté invented his "accumulator" or storage battery, consisting of two lead plates immersed in dilute sulphuric acid. When the element was charged the positive electrode became covered with a layer of superoxide of lead. When this plate was used as a cathode a powerful current was obtained, the super-oxide decomposing again.

In 1859 Moses G. Farmer of Newport illuminated his house with forty-two platinum incandescent lamps, one of the earliest instances of the use of electric lighting.

The idea of separating iron magnetically goes back to 1792, when William Fullerton took out a patent on an apparatus. Electromagnets were proposed by and used experimentally by Arthur Wall (1847) and Chenot (1854). A great step in advance was taken in 1858 when Quintino Sella used an electromagnetic machine for the preparation of ore. He seems to have used the device practically in obtaining iron free from copper and sulphur and was thus enabled to utilize ores for which there had been no practical use. Edison made vast improvements along the same lines many years later.

### Improvements in Metallurgy.

The first modern coke oven of the by-product recovery type was built in 1856 by Carvès at Lebrun, Commentry. After the oven had been improved by Carves and Knab in collaboration, eighty-eight ovens were built in 1862 at the Usine du Marais in Terrenoire.

The principle of centrifugal casting in the production of iron and steel, although proposed as early as 1859, was practically carried out by Henry Bessemer in 1856. In order to avoid blowholes, the molten mass was poured into a circular closed mold having a vertical axis which could be turned with a speed of 2,000 revolutions a minute. A similar process of producing wagon tires was disclosed by Withley and Bower in 1864.

The first modern hydraulic press was built in 1858 by Robinson and Gotham for iron works, but hydraulic press forging was substituted for the hammer in 1861 by John Haswell, whose first press had an effective pressure of 16,000 hundredweight. Haswell's press was improved by Reiner Daelen in 1865 by applying steam pressure directly, thus dispensing with a pump and an accumulator.

The idea of using slag for the making of Portland cement was suggested in 1862 by Eugen Langen, who noticed that the blast furnace slag of an iron foundry had hydraulic properties when granulated. Langen's suggestion was practically carried out in 1865 by Fritz Lürman, who made artificial building stone of granulated slag and limestone under pressure.

Most important in its general industrial effect was the invention of the regenerative gas furnace by Friedrich and William Siemens in 1856. Edward Cooper applied Siemens's regenerative principle to blast furnaces in 1859, his ideas being readily accepted in the Cleveland district.

### Colonel Drake Strikes Oil.

On August 28th, 1859, G. L. Drake, while driving an artesian well, struck oil. Although petroleum had been known even in ancient times, Drake's was the first oil well. Ever since his time petroleum has been an article of commerce. The idea of the pipe line suggested itself as early as 1860 to J. D. Karns and Hutchinson. Their attempts at piping oil were not very successful. The first really successful pipe line was laid by Samuel Van Syckle in 1865 between Pithole and Miller's Farm. Another pipe line was built by Henry Harley at the end of the year and the success of the principle was demonstrated by him.

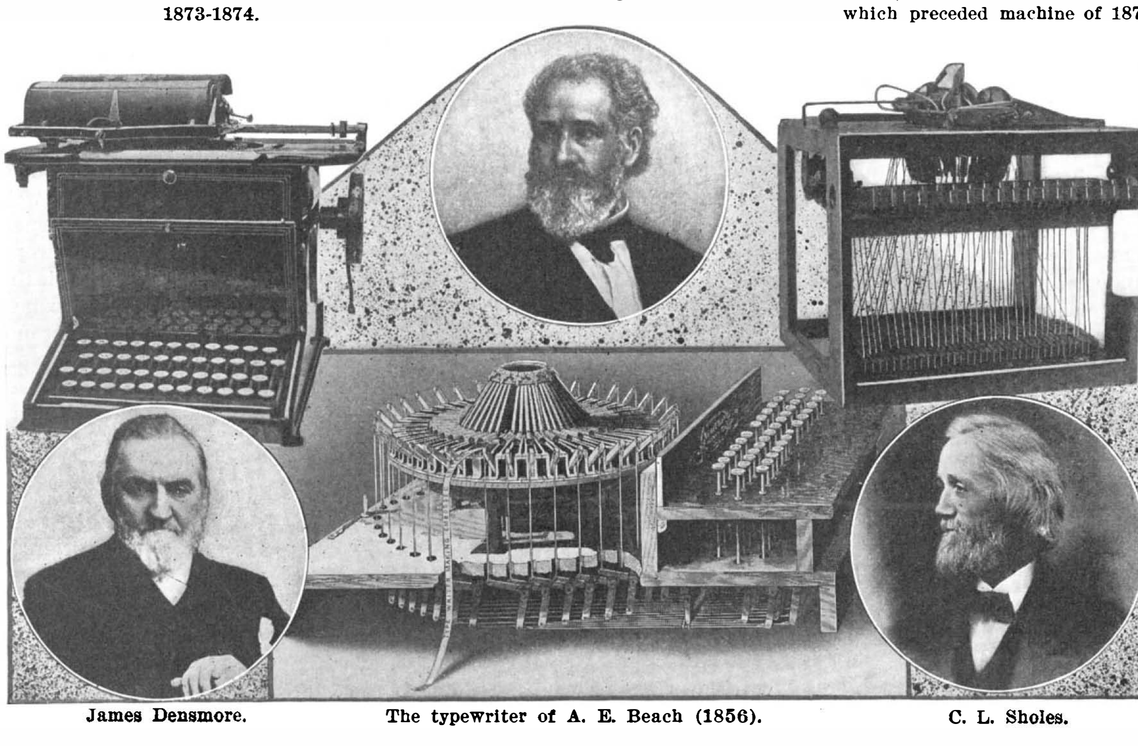
### The Beginning of Modern Refrigeration.

The modern ammonia absorption ice machine was devised in 1860 by the French engineer, F. P. E. Carré. In this machine water was brought to the freezing point by the rapid evaporation of condensed ammonia. Improved by Reis (1870) and Koch and Haberband (1871), this machine held its own until the compression apparatus was brought to a high state of efficiency. A closed cold air or refrigerating machine was built in 1862 by A. C. Kirck. This machine used the same air over and over again and exerted its cooling effect indirectly through tubular walls which are built in the chamber or fluid to be cooled.

### How the Pump Was Improved.

Finding that his early pump lacked smoothness in operation, Worthington developed the duplex pump, which he patented in 1859. Another inventor who did much to improve the pump was George F. Blake. In 1862 he installed and operated his first single direct-

Sholes-Glidden machine 1873-1874. | P. Remington. | Sholes, Glidden and Soulé machine which preceded machine of 1873.



James Densmore. | The typewriter of A. E. Beach (1856). | C. L. Sholes.

Ancestors of the modern typewriter.

action pump, which was immediately successful, and with slight modifications was patented on April 12th, 1864. In the same period belongs the development of the Knowles pump.

In 1862 attention was drawn to the need of better protection against fire in Lockport, N. Y., and in 1863 Holly constructed the first water-works plant, consisting of a rotary pump, turbine water wheel, about one mile of water main and twelve fire hydrants, under what has since become known throughout the world as the Holly system of water supply and fire protection for cities and villages.

In steam engineering we must note that in 1858 John Elder combined the compound steam engine with the surface condenser, and thus devised a type of double-expansion compound engine, which has markedly influenced the development of marine engineering.

In 1860 Lenoir patented his historic gas engine, in which he actually used electrical ignition.

**The Harvester is Developed.**

Sylvanus D. Locke of Janesville, Wis., during these years was working upon a wire binder. He took out many patents, and in 1873, after associating himself with Walter A. Wood, built and sold probably the first automatic self-binding harvester that was ever put upon the market. The different builders of reaping machines were at work at this time perfecting automatic binders which they were attaching to harvesters of the Marsh type, by removing the platform upon which the men stood and placing the automatic binder so as to receive the grain as it is delivered from the elevator of the harvester. The use of wire, however, as a binding material met with opposition, and the inventors turned their attention to perfecting an attachment that would bind with cord; and to Marquis L. Gorham of Rockford, Ill., who built a successful cord binder and had it at work in the harvest field in 1874, must be given the credit of producing the first successful automatic self-sizing binder. It bound with cord and produced bundles of the same size. It was like McCormick's reaper a machine that contained the essential elements that have been found in every grain binder since its time.

In 1879 John F. Appleby took out a patent on a machine upon which he had been working for about four years, which in the arrangement of the devices was an improvement to that of Gorham. It, however, contained the principles of the Gorham machine, which he had seen in operation in the field before he began to work upon his twine binder. The modern twine binder is, in the form of its devices and the arrangement of its parts, built upon the Gorham plan, as improved by Appleby.

A few years prior to 1859, P. H. and F. M. Root conceived the idea of developing a water wheel built on the principle of the present two-lobe positive pressure blower. The machine was constructed to be used as a water wheel. It was installed and tested out, but as the rotating parts were lagged with wood, the wood swelled. The machine was taken out and brought to a machine shop in Connersville and the impellers were trimmed off with an ordinary plane. While they were running the machine to see if the clearances were properly made, the operator of a local foundry was standing by and observed that it was discharging a blast of air. This foundryman afterward became the foreman of Root brothers' foundry. This suggested to the brothers the idea of constructing a positive pressure blower for foundry work—the inception of the positive pressure blower.

**The Solvay Soda Process and Other Interesting Processes.**

The decade brought forth the Solvay soda process, one of the great achievements of industrial chemistry. After the experimental ammonia-soda factory of Dyar and Hemming (1838) had proven more or less a failure, as well as the experiments of Deacon and Gaskell (1854) and of Schlösing and Rolland (1855) in Tetaux, the Belgian chemist and engineer, Ernest Solvay, took up the idea again, invented the mechanical appliances for carrying out the reaction, and succeeded in placing the ammonia-soda process on a commercial par with the LeBlanc soda process (1861).

**Printing Presses and Textile Machinery.**

The type revolver printing press was in general use until Bullock introduced his stereotype perfecting press in this decade. This cut the sheets from a web before they went to the printing cylinders. Between 1862 and 1864 Andrew Campbell put out the first cheap cylinder press, the "Country Campbell," by means of which small newspapers were liberated from the Washington hand press. Campbell then built his two-revolution printing machine (1865-1870), which has since become the standard press throughout the world.

In 1857 Snell and Bartlett patented their mechanical let-off for warps, an important improvement in textile machinery. The principle of this warp let-off was to actuate the large warp beam containing the warps at the rear of the loom by a ratchet and pawl connection with the oscillating lay, the movement of this ratchet and pawl-actuating mechanism being controlled by the tension of the warps. This form of let-off, with little improvement, was applied to cotton looms up to 1888.

It was in this decade that George Pullman introduced the Pullman car. He improved it rapidly year by year. In 1867 he devised the combined drawing-room car, which could be converted into a sleeper at night.

**An Early Submarine.**

Bushnell in 1775 built the first practical submarine boat, and Fulton in 1801 employed the usual vertical rudder and a horizontal rudder. Although Bauer, a Bavarian, constructed a submarine vessel in 1850, no substantial advance was made until Bourgeois and Brun completed "Le Plongeur" in 1864. Her novel feature consisted in her compressed air system for under-water propulsion, which worked satisfactorily; but her submerged control was bad. She had an additional boat, carried in the superstructure, into which her crew could enter through double hatches, then release this small boat and ascend to the surface in case of an emergency.

**Shoe Machines Appear.**

The year 1858 marks the beginning of the wonderful modern shoe machine industry, for then it was that Lyman R. Blake invented a machine which sewed the soles of shoes to the uppers. The machine was financed and improved by Gordon McKay and became known as the McKay sewing machine. The first machines were introduced in the factory of William Porter & Sons, Lynn, Mass., in 1861 or 1862 and were run by foot power. This invention, probably more than any other, is responsible for revolutionizing the manufacture of shoes. In 1862 Auguste Destouy invented a machine with a curved needle to sew turn shoes, which was improved by Daniel Mills in 1869. This machine was adapted by Charles Goodyear to the sewing of welts. Goodyear patented his machine in 1871 and 1875. These patents were the foundation of the famous Goodyear welt system of manufacturing shoes.

**How the Modern Typewriter Was Evolved.**

A marked advance in typewriting machines was made in 1856 by Mr. Alfred Ely Beach, Editor of the Scientific American and one of the founders of Munn & Co. This machine was primarily intended for the printing of embossed letters for the blind, but could also be adapted to the general uses of the typewriter. It employed pairs of dies to imprint characters on a narrow ribbon of paper. These were ranged about a circle, each pair swinging to a common center, much in the manner of the modern typewriter.

During the winter of 1866-1867 C. Latham Sholes, a printer and editor by trade, and Samuel W. Soulé, also a printer, inventor and farmer, were engaged together in developing a machine for serially numbering the pages of blankbooks. At the shop where they were having their work done Carlos Glidden, the son of a successful ironmonger of Ohio, was also engaged in developing a mechanical "spader" to be used instead of a plow. Glidden became interested in Sholes's machine and suggested the idea of devising a mechanism which would not only write numbers, but also letters and words. In the following year a copy of the Scientific American fell into the hands of Mr. Glidden. It described a machine called the pterotype (winged type), invented by John Pratt, which was designed to do just what Glidden had suggested. This article was brought to the attention of Sholes. Glidden, Soulé, and Sholes eventually formed a combination to develop a practical machine. Glidden contributed suggestions; the first crude model was largely the work of Soulé, who suggested the pivoted types set in a circle and other minor details; Sholes contributed the letter-spacing device. By September of that year the first machine had been made. It was a success in so far as it was able to write accurately and with fair rapidity; but it was not yet a commercial machine. One of the letters written on the machine reached James Densmore of Meadville, Pa. He was attracted to the new enterprise and purchased an interest in it. He did not see the typewriter until March, 1868. He urged further improvements, pointing out many defects. Soulé and Glidden dropped out of the enterprise and left it entirely to Sholes and Densmore. Inspired by Densmore, Sholes made model after model. At last by 1873 the machine had been developed so far that it was felt it could be manufactured, and with that end in view Densmore came in 1873 to the gun factory of E. Remington & Sons of Ilion, N. Y. At the factory of the Remingtons the machine was further developed and was finally placed upon the market about the middle of 1874. From that time on the typewriter began to work its way into every business house, until now very few business letters are written by pen.

## 1865-1875

Modern electrical engineering is placed on a sure footing in this decade; for we find not only the dynamo and the motor vastly improved, but new applications of the electrical current.

In 1869 Z. T. Gramme combined the Pacinotti ring armature, which he had reinvented quite ignorant of the Italian's pioneer work, with the Siemens dynamo. Hence he constructed what is considered to be the first dynamo-electric machine for delivering a continuous direct current. Who first discovered the modern dynamo it is hard to determine. Certainly the correct principle of the dynamo was set forth by Werner von Siemens. In 1877 he found that the mass, form and magnetic property of the magnetic parts reinforced one another to a certain maximum when properly designed, and built a dynamo-electric machine in which he used a double T armature. A fortnight later Charles Wheatstone published the principle of the dynamo.

Wheatstone and Cooke had made experiments in 1845 with a magneto machine in which electromagnets were substituted for the previously used horseshoe magnets. The same idea was practically applied by Henry Wilde in 1867 to construct an alternating current machine. Between two rows of electromagnets of opposite polarity a corresponding number of armature spools with iron coils rotated.

H. Fontaine and Z. T. Gramme exhibited the principle of power transmission from an electric generator to an electric motor at the Viennese Exposition in 1873.

In telegraphing the decade is memorable for the invention by Edison of his duplex system and his quadruplex system, and for the laying of the first cable (1866) from Ireland to Newfoundland through the efforts of Cyrus W. Field, John Pender and James Anderson.

**Some Mechanical Marvels of the Sixties and Seventies.**

Mechanical marvels in their day were machines to which we have become so accustomed that they are accepted as a matter of course. It was considered remarkable, and so it was, when Jacob Reese, an American inventor, in 1875 built a machine for cutting iron and steel with rapidly rotating disks of soft iron. The technical press of 1872 commented with admiration on A. Brandon's file-making machine, which, in imitation of hand labor, applied chisel and hammer separately, but which, however, could be used only for making flat files. It was improved by Maurice Mondon of London, in 1874, so that convex filing surfaces could be made. The modern machine, however, was invented by Disston of Philadelphia. The idea of rolling instead of forging files was carried out in 1864 by B. H. Dodge, who constructed a machine for that purpose.

Most wonderful of all was the rotary knitting machine, built by Lamb of Valparaiso, Indiana, in 1866. This machine was afterward improved by Dubied and Watteville. It makes a stocking without any seam whatever.

Benjamin C. Tilghman invented the sand blast in 1871 for producing mat glass. His invention was afterward introduced into the iron and stone industries.

Tilghman is also to be credited with the invention of chemical wood pulp, although ground wood pulp had been known since 1840, when Friedrich Gottlob Keller took out letters patent in Germany for a wood pulp grinding machine; the process of manufacture was not developed and applied for producing paper suitable for newspapers until a much later date. It began to be used commercially about the time of the discovery by Benjamin C. Tilghman of the disintegrating action of sulphurous acid upon wood, which resulted in the invention of chemical wood pulp (1866). After Tilghman in America had pointed the way, George Fry and his collaborator. Ekman, developed at Bergvick, Sweden, the process of separating the cellulose of wood by boiling it under pressure in an aqueous solution of sulphur dioxide in which magnesium sulphite was dissolved. The Ekman process, which was first worked in the liquor used for cooking wool, consisted of an acid solution of magnesium sulphite, the magnesia being obtained by burning magnesite imported from Greece.

**Advances in Metallurgy.**

In 1862 Joseph Moore of San Francisco brought out the California stamp mill, which became of great importance in mining. The dry concentrator in which air is employed for the separation of minerals was introduced in 1868 by Stephen R. Krom. Another improvement which meant much to the mining industry was Dingey's mineral mill (1872) consisting of a slowly revolving horizontal slotted plate over which four notched disks rotated in the opposite direction. This machine proved twice as efficient as the stamp mill.

George Bedson of Manchester in 1867 invented a continuous wire rolling mill. He was the first to roll out metal bars weighing one hundred pounds into wire at the rate of eleven tons a day. He arranged his rollers in alternate vertical and horizontal pairs.

**Westinghouse and the Air Brake.**

Railroading received a great impetus by George Westinghouse's invention of the air brake. It was in 1875 that he brought out this the first successful invention of the kind and one which made high speed railway travel possible. Year by year Westinghouse continued to improve the brake, giving it his personal attention until far into the twentieth century.

Another railway development of importance was the advent of the automatic block signal system (banjo signal) invented in 1871 by Thomas J. Hall, and soon widely adopted in the United States of America.

An invention which attracted but little attention at the time, but which was the beginning of the reinforced concrete industry, appeared in 1867. Then it was that José Monier patented a method of making flower pots out of cement with a reinforcement of iron netting. This seems to be the first instance of the utilization of reinforced concrete. In additional patents, taken out in 1868, 1873, and 1875, Monier extended the principle to bridges, staircases, railway sleepers, and the like, thereby proving that he was keenly alive to the possibilities of his discovery.

The first great modern vacuum ice machine (the principle was proposed as early as 1810) was exhibited by Edward Carré at the Paris Exposition of 1867. In this machine water was used as the vaporizing fluid and concentrated sulphuric acid as the absorbing fluid.

In 1873 Lowe and White invented the modern water gas process. They blew steam into a layer of red hot coke and carbureted the resultant gas with oil. Another improvement in the art of illumination was that of C. Tessié du Motay, who invented the zircon light in 1867, in which a pencil of zircon was heated to incandescence in a gas blowpipe. Clammond, in 1872, hit upon the idea of bringing magnesia to incandescence in a blowpipe. In a sense he was the forerunner of Welsbach.

**Some Important Inventions in Industrial Chemistry.**

Important advances were made in industrial chemistry. After Parker of Birmingham and Daniel Spiller had independently endeavored in 1862 to make utensils of a dried solution of nitrocellulose, but without success, J. S. Hyatt discovered in 1869 that camphor is a solvent for various kinds of nitrocellulose and thus established the great modern celluloid industry.

Dynamite was invented in 1867 by Alfred Nobel. He discovered the extraordinary absorptive powers of the infusorial earths for nitroglycerine.

Madison improved the bicycle in 1867 by providing it with radial wire spokes. This was the basis of Reynard's tangential spokes (1883) now used on all bicycles.

In 1866 O. S. Halstead of Newark, N. J., completed a submarine vessel still to be seen at the Brooklyn Navy Yard. This vessel, the "Intelligent Whale," had a trap door, which opened in the bottom of the vessel. After filling the entire vessel with compressed air to the depth of submergence the trap door was to be opened and the whole vessel converted into a diving bell. The craft was never put into commission.

**Tunneling Under New York.**

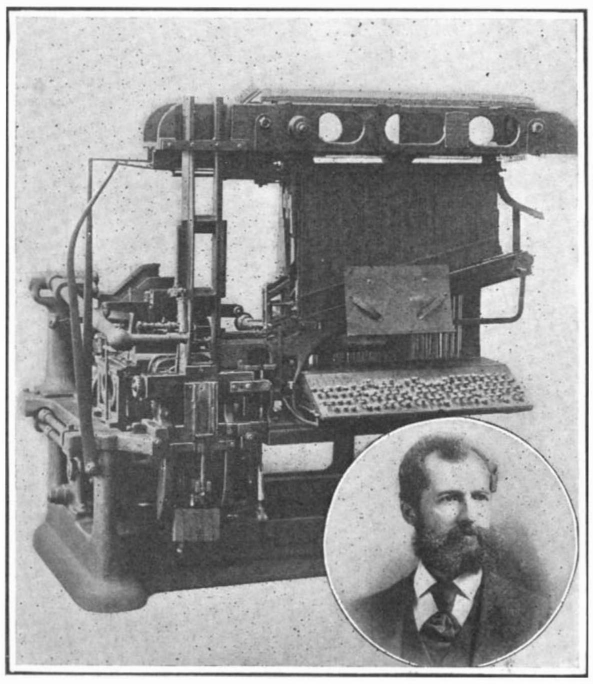
On September 5th, 1865, Alfred Ely Beach, editor of the Scientific American, patented a plan for conveying letters and parcels by mechanical means directly to a Central Post Office from a lamp-post letter-box. In the following year he learned of the success of experimental pneumatic tubes in Great Britain, through which small cars carrying merchandise and persons in a sitting position were successfully operated. Thereupon he invented a plan of dispatching letters pneumatically. X-shaped revolvable valves in lamp-posts were intended to catch the letters as they were dropped from above, and to hold them until the pneumatic car came along, into which they were emptied automatically. This system was patented November 13th, 1865. He built a model which was exhibited at the American Institute Fair in the autumn of 1867. A company called the Beach Pneumatic Transit Company was then organized to lay pneumatic tubes under Broadway and the East River for the transmission of mail and parcels. In order to tunnel under Broadway, the modern tunneling shield, suggested as early as 1824 by Brunel, was practically applied. The shield was pushed forward in a modern way by a series of hydraulic rams, which system Mr. Beach patented June 8th, 1869. With this shield a tunnel was driven under Broadway from Warren Street to Murray Street. A car was propelled through this tunnel by means of a blower, the blower being reversed so as to suck the car back when it had reached the end of its travel.

**The Elevator is Improved.**

Almost simultaneously with the steam elevator appeared the hydraulic elevator, which in its simplest form was a ram located under the carrying platform, which was moved up and down by water under pressure, working in a closed cylinder. This system of operation was first put into practical use in 1872.

After many vicissitudes the hydraulic elevator was improved, and is now in use in many modern buildings. Following this type came the geared hydraulic, in which the ram became a piston, which was attached to the moving element of a system of multiplying sheaves, over which the elevator cables were passed, thus enabling a short cylinder to effect a high lift. Hydraulic elevators were greatly developed between 1880 and 1890, during which time they almost entirely displaced the steam operated variety, and further developments were made from 1890 to 1900, when the height of buildings began to increase rapidly.

With the increased height came a demand for greater speed, but although this requirement was well met by the hydraulic, it had the objection of being uneconomical of space, and the plunger type increased greatly in cost with increased lift. The natural result of these conditions, which were steadily progressive, was to suggest electric power for operating all kinds of elevators, and the first electric elevator was installed in 1887. The first successful electric passenger elevator was built in 1889 by Otis Bros. & Co. and installed in a building on Fifth Avenue, New York. This was of the drum type, and while occupying little space this construction was ill adapted for buildings 400 to 500 feet high, on account of the enormous size of the drum necessary to wind the hoisting cables. These conditions led to the introduction in 1906 of the electrically operated traction machine, which was located directly over the elevator shaft, and includes the driving sheave. The car is suspended from one end of the cable, and a counterweight from the other. The cables pass over the driving sheave, thence around an idler and again around the driving sheave, thus forming a complete loop around these two sheaves. The driving sheave is operated through a worm gear by a moderate speed electric motor. By this arrangement the hoisting cables are given sufficient grip on the traction sheave to lift the load, while the machine is compact, economical of operation and practically solves the problem of high lifts at satisfactory speed and with perfect control. Another type of machine widely adopted is an improvement of the geared traction model by eliminating the intermediate gear, and driving the traction sheave direct by a highly efficient low-speed electric motor, and this style of machine has been almost universally adopted for skyscraper service; and in fact it is due entirely to the improvements made in elevator machinery that the skyscraper has become a possibility.



Ottmar Mergenthaler and his first commercial linotype.

## 1875-1885

If there is one invention that can be said to stand out more than any other in this wonderful decade, it is the invention of the electrical incandescent lamp, not only Edison's most brilliant success, but one of the greatest technical achievements in the annals of invention. Edison owed his success to clear thinking and hard work; for many another had been at work along the same lines. Edison brought his elaborate investigation of various possible filament materials to a conclusion in 1879, or at least to a point where practical results might be expected. In that year he substituted carbonized bamboo fiber for other filament materials. He was the first to recognize the fact that the filament must have a very high resistance to be efficient. His installation of one hundred and fifty incandescent lamps on the steamship "Columbia" must be regarded as the first practical illuminating plant in history. The general introduction of the incandescent lamp followed the startling exhibit Edison made in Paris in 1881.

The Edison incandescent lamp patents proved a fruitful source of litigation, but were sustained. Among the inventions unsuccessfully cited as anticipations were Sawyer's lamps (held to be included in Edison's claims) and the Jablochkoff "candle," which was invented in 1876 by the Russian engineer whose name it bears, and which was remarkable chiefly because it showed the possibility of what may be called the sub-division of light.

The problem of distributing current was certainly one of great practical difficulty and one which had to be solved before electricity could be made cheaply available. It is impossible to place the credit for the solution where it belongs. Edison certainly solved it, and so did Weston, both hitting on the idea of the three-wire system.

While Edison was busily engaged in perfecting the incandescent lamp, Charles F. Brush was experimenting with arcs. In 1878 Brush gave to the world the now famous Brush electric arc light, which was first adopted by the municipality of Cleveland. The light is still in service in essentially its original form.

In 1878 Charles F. Brush introduced his famous compound dynamos. Edward Weston's dynamos, too, were among the earliest in the market.

Gaulard and Gibbs (1880) worked out a system of distributing alternating current at high tension. They utilized induction coils, which were transformers, but which they called "secondary generators." This early transformer was one of the first steps which rendered it possible to transmit electric energy to great distances. The term transformer came into use in 1882 when Karl Déri and Karl Zipernowsky showed that by arranging the Gaulard secondary generator in parallel and by better distributing the windings and iron masses the practical requirements of every distribution system would be more fully met. Transformers revolutionized alternating-current engineering and opened up an entirely new field.

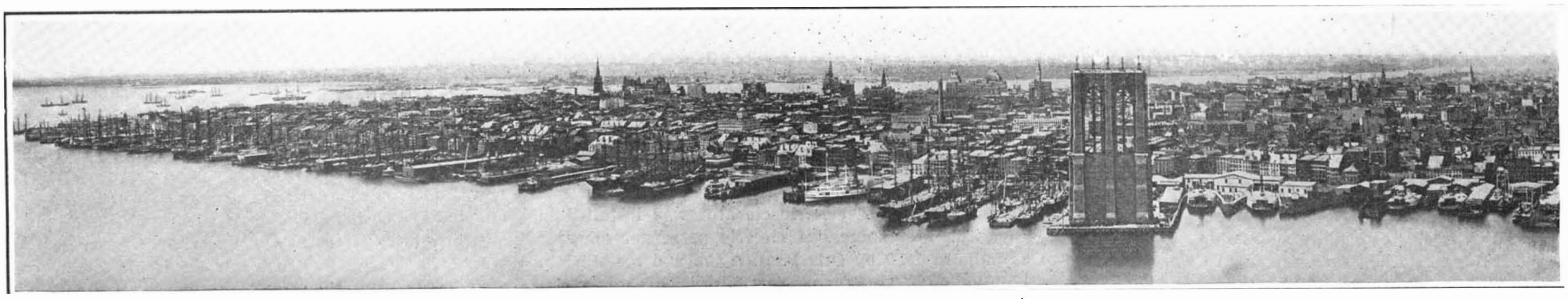
The modern transformer system, which involves transmission from a station of high potential and the reduction of the potential in the secondaries of transformers, was worked upon in a small way at the Franklin Institute in Philadelphia in 1879, and in February of that year Prof. Elihu Thomson ran two transformers by an alternating dynamo of his own construction, the fine wire primaries of the transformers being connected in parallel with the dynamo line and the secondary currents of low potential used in doing local work. Later on this pioneer work was taken up (especially after satisfactory safety devices had been produced by him) and patent 698,156, applied for on November 2nd, 1885, went through the fire of interferences from applicants here and abroad, and finally was issued with broad claims. In fact, an epitome of multiple arc distribution systems may be found in the record of interferences and other procedures in which this patent was involved. It was issued, after a long contest, in 1902.

Another electrical worker in this wonderful decade was Edward Weston, a pioneer who did much to lay the foundations of the present electrical industry. He it was who placed the art of electroplating on a really scientific footing. In 1872 he substituted dynamos for batteries in plating, and that at a time when dynamos and the distribution of electric current were still embryonic. His work in the development of the dynamo has never been fittingly recognized, especially his introduction of the laminated core in 1879. In 1874 he brought out his arc light dynamos, and from 1880 on he developed dynamos for incandescent lighting and power. Before his day it was the practice to run each arc light from a separate dynamo; he showed, probably for the first time, that arc lamps could be run in series from a single generator. As early as 1878 he devised and patented the flaming arc. He also described the cored carbon about the same time. He was the first to make arc lamp carbons in great quantities and the first to copper-plate them. From 1875 on he worked in the field of incandescent electric lighting, succeeded in producing a homogeneous carbon filament, and devised the hydrocarbon treatment process in 1875-1876. He was one of the first users of the electric arc furnace in an industrial way; for he used it in 1875-1876 to melt platinum.

Weston early realized that accurate electrical measuring instruments were a vital necessity in electrical engineering. To him belongs the credit of having devised, after infinite pains, simple electrical meters which made the measuring of volts and amperes as easy as reading the dial of a groceryman's scale.

To make light, portable, accurate instruments involved the discovery of alloys which would avoid the necessity of making correction calculations. He gave the world manganine, an alloy combining a very small temperature coefficient and a high resistance. He also gave the world several alloys with negative temperature coefficients.

In 1884, at the first American Electrical Exposition in Philadelphia, Frank J. Sprague made a sensation with his new motors. They not only gave a tremendous stimulus to central station development, as a source of supply of electrical energy, but set going a furor as to electrical traction. Sprague's stationary motors for industrial power are in use to this day. The year 1887 marks an epoch in electric traction throughout the world. Sprague's first real street railway was that for St. Joseph, Mo., but the vital point was reached when he took a contract to equip and operate a new system at Richmond, Va., with no fewer than forty cars. All was crude, but the goal had been reached,



**New York in 1876. The Brooklyn Bridge is in course of construction. New York's skyline would be essentially the same to-day had the passenger elevator not been invented.**

and with one great mighty leap the trolley came into its own.

### The Advent of the Telephone.

Never before did electrical inventions of great value follow one another so rapidly. Indeed, it was the decade of electricity. Alexander Graham Bell invented the telephone (1876), which instrument was rapidly developed. In 1877 Emil Berliner patented the microphone transmitter, based upon the principle discovered by Du Moncel of altering the resistance of two conductors by pressure. In the same year Edison constructed his carbon telephone. To Berliner and Edison belongs the credit of having made the telephone a commercial invention.

An electric railway was built for the Berlin Industrial Exposition (1879) by Werner von Siemens. Here, for the first time, an electric current from a permanent source was led through a conductor running alongside of the track. The first public electric railway was that built in 1881 by Siemens and Halske running from the Anhalt railway station in Berlin to Lichterfelde. In 1885 the Thomson-Houston International Electric Company introduced the principle of using the rail to return the current and also the now familiar motorman's controller for regulating the speed of the car.

John Hopkinson made his classic experiments with alternating currents in 1884 at the South Foreland Lighthouse, as a result of which he laid down the conditions under which two alternators may be operated in synchronism. In the same year Elihu Thomson discussed the electro-inductive repulsion exerted by alternating current magnets on copper disks. Two years later he built his repulsion motor. In 1885 Ganz & Co. built an alternating-current dynamo (Déri-Zipernowsky's patent). This was probably the first alternating-current machine for central station use connected in parallel. All this was based on the work done by Wilde in 1868, by Marcel Déprez, and, above all, by Hopkinson.

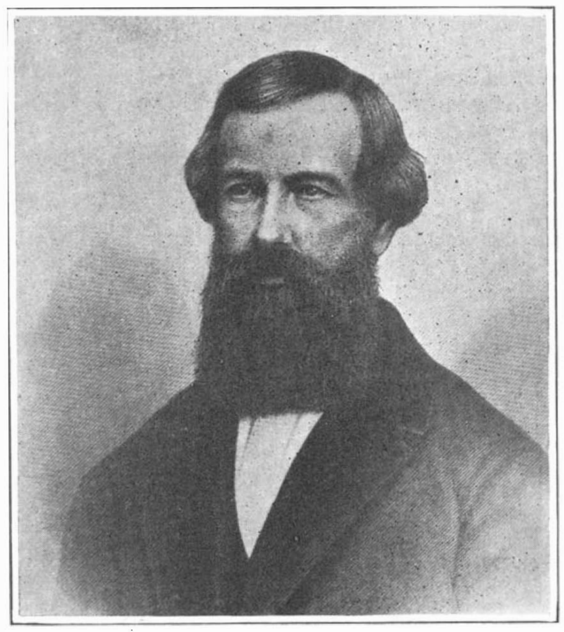
In 1885 Galileo Ferraris built a motor, consisting of a pair of electromagnets, supplied by alternating current differing by 90 degrees in phase, so that the interior rotary portion was set in motion, thus showing that it was possible to split a given alternating current into two parts, the one having a resistance free from induction, the other having self-induction. As a rotary motor armature, Ferraris employed a hollow closed copper cylinder.

### Elihu Thomson's Inventions.

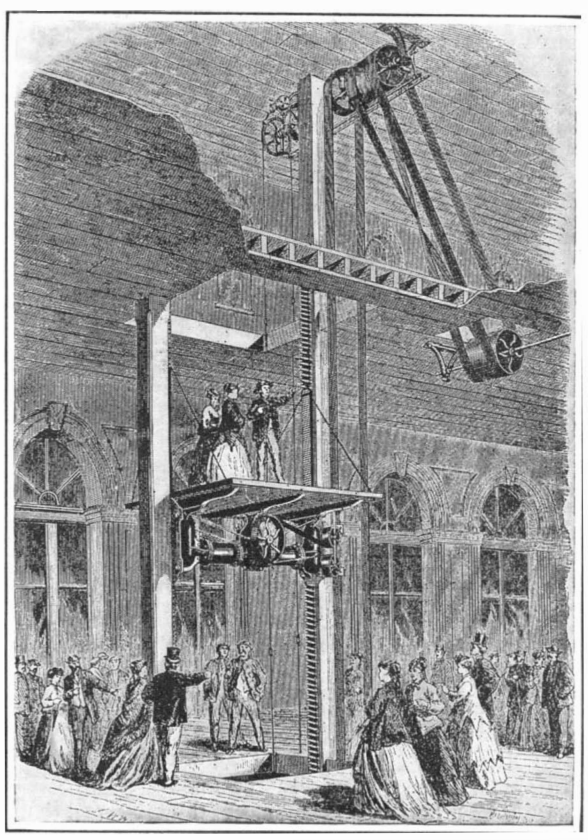
The Thomson-Houston arc lighting system began with the invention of the arc dynamo in 1879, which was patented in 1880. The specification as originally filed related not only to a direct-current machine, but also to a *three-phase alternator* with collecting rings. The machine is, in fact, the first example of a three-phase machine with or without commutation.

The Thomson-Houston constant current regulator, patented in 1881 and 1883, had a profound influence on giving the Thomson-Houston system an early start in the industry, as it maintained a definite value of current from a series line, no matter how many lights were in use. This regulator had a very extended use, and in modified form survives to-day.

Another pioneer element in the Thomson-Houston arc dynamo (1882 and 1883) was the air-blast, which overcame the difficulty of short-circuiting across the commutator slots, known as "flashing." These inventions, also, are prototypes of oil switches and switches furnished with air-blasts for extinguishing arcs.



**Elisha Graves Otis, inventor of the passenger elevator.**



**The steam elevator of 1870. From a contemporary engraving.**

The magnetic blow-out system so generally employed was first developed with the Thomson-Houston enterprise, and it has had a profound influence on all forms of control apparatus, arresters, etc. It is found in first forms in patent 283,167 of August 14th, 1883. A strong magnetic field is employed for disturbing or extinguishing the arcs formed when electric contacts are opened and when considerable voltage and considerable current are flowing. This principle is now employed on a very extended scale and is likely to be employed still more in the future. Most electrical engineers are familiar with its present relation to the art.

When incandescent lamps are run in series, one with the other, on street lighting circuits, all the sockets which suspend them are provided with film cut-outs, that is, a film of insulation is so placed in shunt to the lamp that when the lamp cuts out or is removed, the film is punctured, and thus a safety short-circuit is made around the lamp. This appears in connection with the series lamp in Thomson's patent dated September 16th, 1884. For similar purposes vacuum cut-outs were invented and have attained a certain amount of use in recent times, and the prototype is 307,818 of November 11th, 1884.

Camille Faure improved Planté's accumulator in 1882 by inventing the pasted type of storage battery. Planté formed his super-oxide of lead after charging; Faure used a compound of lead oxide and lead super-oxide, which he applied directly to the negative electrode.

In 1883 Gaston Tissandier built the first electrically-driven dirigible airship. Much more important were the experiments of Rénard and Krebs of 1884. Theirs was the first really intelligently designed airship from the modern standpoint. The propeller was driven from a dynamo; the envelope was remarkable for its approximately correct aerodynamic form.

In 1883 Sir Hiram Maxim invented his automatic (self-loading) machine gun, in which he utilized the force of the recoil to reload the weapon as well as to fire it automatically. Most modern machine guns have been based upon this early weapon of Maxim's.

### Edison's Remarkable Activity.

The decade was the most active in Edison's remarkable career. He perfected his motograph, his automatic telegraph systems, his duplex, quadruplex, sextuplex and multiplex telegraphs. Of these, the quadruplex system of telegraphy is of almost incalculable importance. It may be safely said that its invention rendered the high-speed printing telegraph commercially unnecessary until the present time. To the same decade belong his microtasimeter, paraffin paper, and carbon rheostat. In 1877 the phonograph appeared, one of his most original and brilliant inventions. Its first public demonstration was in the office of the SCIENTIFIC AMERICAN in the same year. Two years later he brought out his dynamo electric machines, which he designed especially to meet the need of a simple efficient means of generating current for his incandescent lamps. In 1880 he began his work on magnetic ore separation. Then followed (1880-1882) the first full-size experimental electric railway in this country for freight and passengers at Menlo Park, N. J. Not content with inventing, he started to exploit the incandescent light commercially (1881), built the first commercial lamp factory at Harrison, N. J. (1881), and organized shops for the manufacture of dynamos, underground conductors, sockets, switches, and fixtures.

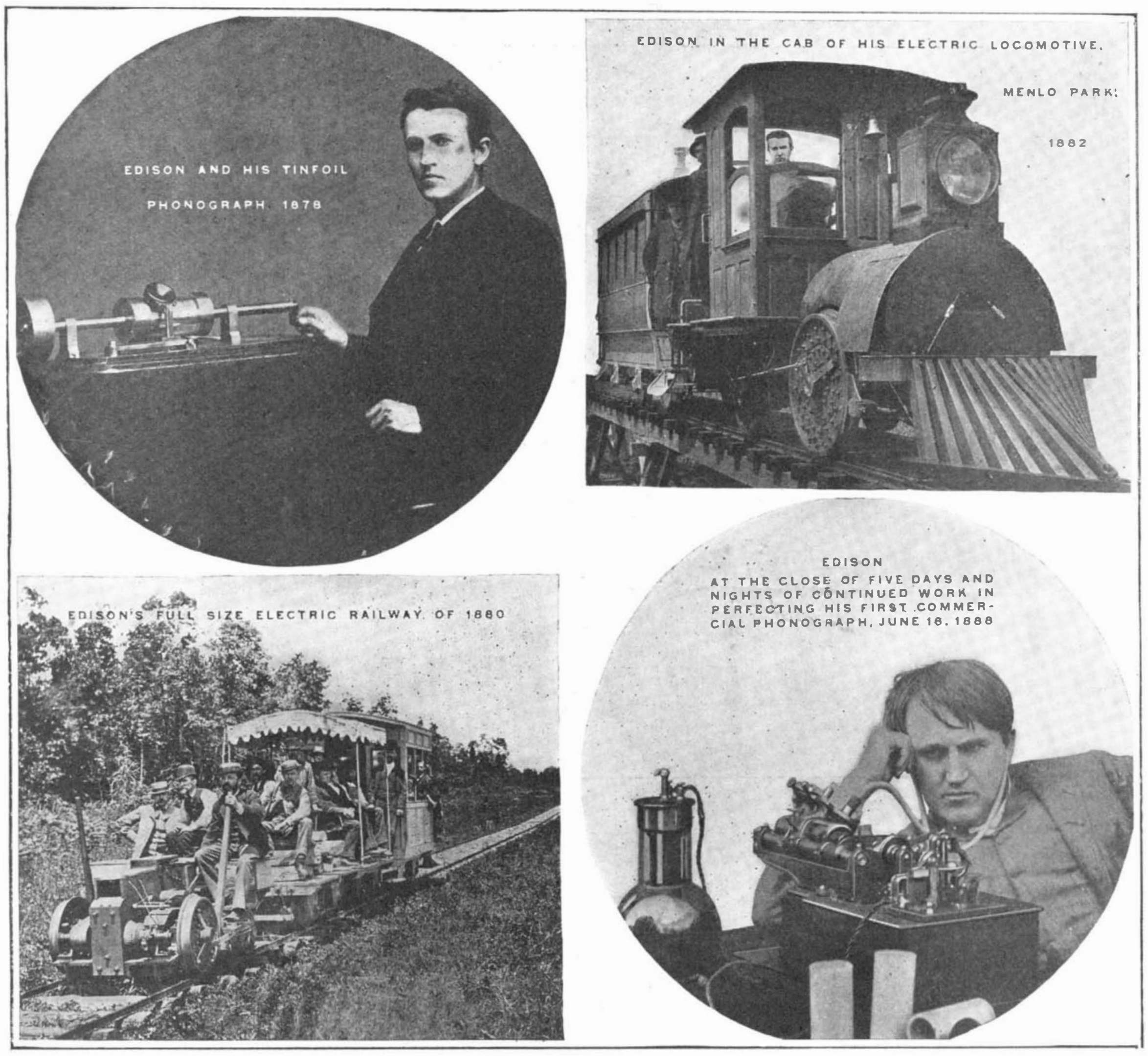
### How the Newspaper Printing Press Was Improved.

Andrew Campbell, famous for his printing press im-

Copyright 1914 by Irving Underhill

**New York's skyline in 1914. An architectural tribute to the influence of the elevator in the development of the metropolis.**

provements, in 1875 developed a press which used curved stereotype plates and printed on both sides of the web itself. Later Campbell added a folding machine. Next he built a double printing machine, each half of which contributed a perfected web to a folding machine common to both, whereby he was able to turn out an eight-page paper. Stephen D. Tucker, an inventor in the employ of Hoe and one of the most brilliant mechanics that this country ever produced, also invented a folder. He applied for a patent (1875); Campbell did not. Hence, one of the most valuable improvements in printing presses fell to the Hoes. At about the same time Tucker invented another device essential to the modern newspaper press—the collecting cylinder, by means of which the product of one circumferential half of a printing cylinder may be transposed upon the product of the following half, and thus the two brought together as a single product. Two Englishmen, Anthony and Rose, conceived the idea of splitting a web of paper into two longitudinal halves and transferring one half over and upon the other by means of deflecting bars, so that the right-hand product of a printing cylinder could be superposed upon its left-hand product and the two made up into one. This invention is now included in all double-width newspaper printing presses. Another improvement came when Ford patented a means for running the product of two printing machines into one folding machine. The rotary folder of Campbell (or Tucker), the collecting cylinder, the angle bar method and the double press arrangement—all very necessary to-day in newspaper presses—came into the possession of the Hoe Company. They were all combined into a single structure, so good that all other presses were driven out of newspaper offices. Very valuable additions were made by Crowell, an ingenious Yankee skipper who could not even read a drawing and had to work from patterns or models. With no knowledge of machine design, he invented the longitudinal folder, by which a web may be folded longitudinally while on the run and still in web form. About the same time (1879-1889) he conceived the idea of the rotary fly. This was the last device necessary to the creation of a 24,000-copies-an hour printing press, and when it was introduced (in the early eighties) the rotary newspaper printing press in all its elements became the machine it is to-day.




**Some of Edison's work in the decade 1875-1885.**

### What the Inventor Did for the Miner and Iron Founder.

Important progress in metallurgy was made. After M. J. Holway had made experiments in bessemerizing copper (1877-1878), following the experiments of Semennikow, M. J. Brown of Sheffield succeeded in blowing Rio Tinto ores in Bessemer converters.

The modern Otto by-product coke oven, an improvement on that of Bauer and Hoffmann, was introduced in 1880. Otto's system has served as the inspiration of most later designers.

Alexander and MacCosh invented the so-called Gartsherrie process for obtaining ammonia and tar from blast furnace gases. The first proposal to utilize waste blast furnace gases for the generation of power seems to have been made by Josef von Ehrenwerth in 1883. Wilhelm Michaelis in 1876 made discoveries which showed that blast furnace slag could be added to Portland cement with advantage.

The first two-cycle gas engine appeared in 1879. It was the invention of Clerk and was distinguished by its separate compression pump, which charged the working chamber and also acted as a scavenger. The first gas engine for locomotives was built in the same year by Marcel Déprez. The gas was compressed in a suitable container, and after having been allowed to work expansively like steam, was mixed with air, exploded, and thus made to do work again.

### Improving the Steam Engine: The Steam Turbine Appears.

In 1880 the French engineer, Serpollet, constructed a steam engine for tram cars, which engine was afterward used in automobiles. The engine was based upon the principle that only enough steam was admitted at each stroke to drive the piston to the end of its travel. A flash boiler was employed. It was not until the American, Stanley, came to the front with his tubular boiler that the steam automobile really came into its own. White, another American automobile designer, compromised between the principles of Stanley and Serpollet, by designing his semi-flash steam generator, which was successfully used.

But the crowning invention in engines was the steam turbine. In 1884 Charles Algernon Parsons of Newcastle-on-the-Tyne invented his multi-cellular turbine, which utilizes steam first on the action and then on the reaction principle. His was the first steam turbine which could be directly coupled with a dynamo.

In the same year Pelton, an American, invented the Pelton wheel, in which cups are used instead of blades, the cups being so designed that they utilize the force of the impinging water to the utmost.

### Mergenthaler and His Linotype.

For many decades inventors had endeavored to supply a satisfactory machine which would rapidly set type and which would enable newspaper proprietors to turn out papers more rapidly than was possible with hand composition. It was not until 1888 that such a machine was invented. It was the invention of Ottmar Mergenthaler, and it worked on an entirely new principle. Instead of seeking to set the types and after their use to distribute them among their respective receptacles in order that they might be automatically composed—the principle on which previous inventors had worked—Mergenthaler composed the type-matrices, and from these cast, as a single piece, a line of characters. Hence, his machine was called a "linotype." Mergenthaler's matrix was of brass, flat and rectangular, having a V-shaped notch cut deep into its upper end, the edges of the notch being lined with small hook-like projections. These projections were arranged to act like the convolutions of a flat lock-key; because of them a matrix could drop from the V-shaped ward bar, from which it hung during its automatic distribution after use, only into its own reservoir or channel of the matrix magazine. The convolutions of all the matrices of each character were alike, but those of no two characters were the same. The matrices were allowed to drop into their proper places in a line in response to the working of a keyboard. They were automatically justified, transported to the casting mechanism and pressed against the mouth of a slot or mold filled at the proper moment with molten type metal. After that the matrices were returned to their respective magazines.

On the heels of the linotype came another device—the "monotype," invented by Lanston, which has found its field more in the book and periodical printing office. The monotype consisted of two independent mechanisms, the one a keyboard by means of which the operator was enabled rapidly to perforate a paper ribbon with holes which represent characters, and the other a type-casting mechanism to which perforated tape thereafter was fed. The latter device comprised a movable frame in which the matrices of 225 characters were fastened, a type mold, automatically adjustable to suit the various widths of the characters of the alphabet, with which a metal pump was connected, and pneumatic mechanisms for controlling the position of the matrix-carrying frame, and the width of the type mold. To these was added a general mechanical organization which enabled the perforations of the ribbon, by means of air, as it was drawn through the machine, to place the matrix frame properly and set the mold for each character needed, while the pump and co-operating parts acted to cast the character and place it in its correct position in a tray, or "galley," at the rate of 150 characters a minute.

### The Invention of the Automobile.

The first really successful modern volatile hydrocarbon automobile appeared in 1883. It was designed and built by Gottlieb Daimler. His success seems to have been due very largely to his automatic hot tube igniter, which was soon used for both stationary and portable internal combustion motors. George B. Selden of Rochester, N. Y., applied for a patent on a volatile hydrocarbon automobile in 1876, but never built a car until he became involved in patent litigation many years later; but to Daimler must be conceded the credit of having given us the modern automobile as we know it. Much credit is also due to Karl Benz of Mannheim, who in 1885 built the first four-cycle volatile hydrocarbon motor with electric ignition, which motor he mounted on a tricycle. Although he designed this in 1885, he did not exhibit it until 1888, and then at the Industrial Exposition of Munich.

### Improving the Submarine Boat.

In 1876 J. P. Holland built a submarine vessel (the "Fenian Ram"), following the Fulton system of control by vertical and horizontal rudders. She was fitted with an air gun which could be discharged under water, and was probably the first submarine torpedo boat, if we give the word torpedo its largest significance. Holland was preceded by a year, however; for in 1875 Garrett of England brought out a vessel which was propelled by a steam engine, steam being given off at gradually reducing pressures. Later Garrett became associated with Nordenfeldt, who added new ideas, among them down-haul screws carried amidships either side of the vessel to haul her under water. By varying the speed of the side propellers the depth of submergence could be controlled. Nordenfeldt built submarines for Turkey, Greece, and Russia. In these internal torpedo firing tubes were fitted for the first time.

In 1880 Alexander E. Brown installed the first mechanical ore unloader to take ore from the hold of a boat and deliver it either to cars or to stock piles without rehandling, an invention that marked the first step in the remarkable American system of ore handling. No radical improvement in the principle of ore unloading was made for nearly twenty years.

### Paper Pulp and Its Preparation.

During this process the Ekman paper-pulp process was markedly developed. Mechanical difficulties surrounded the operation from the start, though the quality of pulp produced was excellent. The digesters in which the wood was cooked were lined with lead and the heat developed in the acid liquor proved to be exceedingly disturbing, as while the lead expanded during the application of heat, it did not contract again when cold. The cost of repairs to digesters necessitated by the behavior of the lead lining was heavy, amounting

to $10 a ton on the total production. The difficulty was overcome by the invention of a digester lining composed of heavy cement backing, faced with brick, the latter being pointed with litharge and glycerin. The invention of a digester lining was one of the important early contributions of the chemical engineer to the development of the industry.

The magnesium bisulphite process originated by Ekman in Sweden, and developed by Charles S. Wheelwright and his brothers in this country at the Richmond mill in Providence, R. I., has been modified in several important particulars, the chemical solvent now employed being bisulphite of lime. Many different kinds of pulp are obtained, according to the system of cooking employed.

The sulphite process of cooking wood is not applicable to all woods. It works best with spruce and coniferous woods generally, and the several qualities of sulphite pulp depend on the system of cooking employed. The Mitscherlich process, which bears the name of the inventor, yields a product by long cooking in a weak solution of sulphurous acid under low pressure, which is remarkable for strength of fiber. The wood is steamed for a few hours before being boiled with the acid liquor. The Rittner-Kellner quick-cook process is an improvement on the other processes, and is the one generally used in this country.

Perhaps the most important invention in pulp-making processes, especially in view of recent work in the utilization of waste wood, dates from 1883, when Dahl introduced the sulphate process for the treatment of straw, a modification of which is now applied to the production of pulp from coniferous woods that are not amenable to other treatment. The operation of boiling in this process is carried out with a solution of caustic soda containing small amounts of sulphate and sulphide of soda. The sulphate of soda does not affect the wood and is used as a source of alkali and sodium sulphide. The principle of the process depends on the fact that in soda recovery, when the concentrated liquors are burned to ash, the sodium sulphate is reduced to sulphide by the carbonaceous matter derived from the wood, while the soda, in conjunction with the organic matter, is converted into sodium carbonate. The liquors are causticized in the usual manner, the lime converting the carbonate into caustic soda, and having little action on the sodium sulphide.

## 1885-1895

Although the decade was not so fruitful in pioneer electrical inventions as that of 1875-1885, it did bring out much that was new and startling. S. Z. de Ferranti built the first alternating current central station of London, remarkable for its completeness of equipment. It served as a model for later installations. The year 1887 is memorable for Tesla's invention of the polyphase alternating current motor, which made it possible to transmit electrical energy economically. On another page in this issue Mr. Tesla has told how this and other inventions of his sprang into being. The first alternating current machine for generating polyphase current seems to have been built in 1888 by Hasselwander of Offenburg. In the same year Charles S. Bradley patented a two-phase motor. The first installation for transmitting multi-phase alternating current at high tension was built in 1891 by Michael O. von Dolivo-Dobrowolski of Berlin between Lauffen and Frankfurt.

### Hertz Lays the Foundation of Wireless.

The year 1887 is memorable for the publication of Heinrich Hertz's classic studies, which experimentally proved that invisible electromagnetic waves can be sent through the ether with the speed of light waves. To prove the existence of the waves Hertz employed secondary conductors of condenser-like form (Hertz resonators). Hertz's work marks the beginning of modern wireless telegraphy.

In 1890 Edouard Branly invented the coherer, the first detector of the electric waves employed in wireless telegraphy. The instrument was independently invented by Lodge. Although it has outlived its usefulness, without it the art of wireless telegraphy might not have developed so rapidly. The tapper, which decohered the iron particles in the tube and thus rendered it responsive again, was invented by Popoff in 1895, without any thought apparently of its subsequent utility in wireless communication.

The telautograph, an instrument for transmitting drawings and writing electrically, was invented in 1890 by Elisha Gray. His instrument had as its essential feature a transmitting stylus or pen, the movements of which were analyzed into two components perpendicular to each other. These components varied the resistance of an electric circuit and caused the receiving stylus to retrace the movements of the transmitting stylus. Improvements were made in 1894 by Cerobottani, Dennison, Gruhn, and Grzanna.

### Electric Welding and Other Inventions of Thomson.

The Thomson electric welding patents were applied for in 1886, and were issued on August 10th of that same year. They were the result of considerable work done before the filing in establishing the art of electric welding. Along with the development of the art of electric welding under the Thomson process there was also electric forging and brazing as instances of the use of electric welding transformers, the peculiarity of which is that the secondary of the transformer consists of only a single turn. The principal patents are 396,009 and 396,010, issued to Thomson January 8th, 1889.

The fundamentals of the Thomson repulsion motor and repulsion apparatus generally were patented May 17th, 1887, the experimental work being done about May, 1885, and onward.

In like manner, attention may be called to Thomson's inventions relating to alternating current magnetic systems, including the "shaded pole" and "shifting magnetism" (1889 and 1890), pioneer inventions in this field.

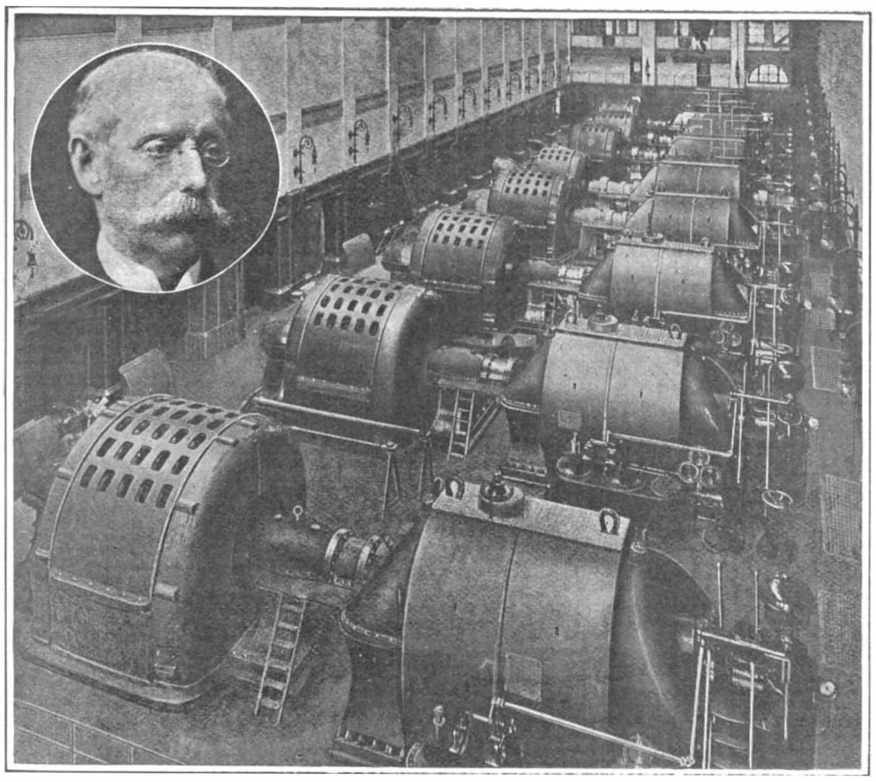
The well known engineering device, known as the "constant current transformer," is seen in its earlier forms in Thomson's patents, 400,515 and 400,516, of April 2nd, 1889.

As bearing on the constant current transformer systems now in such extended use, especially in arc lighting in cities, reference may be made to the pioneer patent, 516,846, granted to Thomson March 20th, 1894. These constant current transformers were based on the principle of repulsion discovered by Thomson years earlier, and they practically supplanted arc light dynamos. They are now greatly used to supply energy to mercury arc rectifiers where direct current is employed to operate a series of magnetite arc lamps. They furnish constant current to alternating current arc lamps, and are likely to be used in the future with the series high power incandescent lamps of the nitrogen filled type.

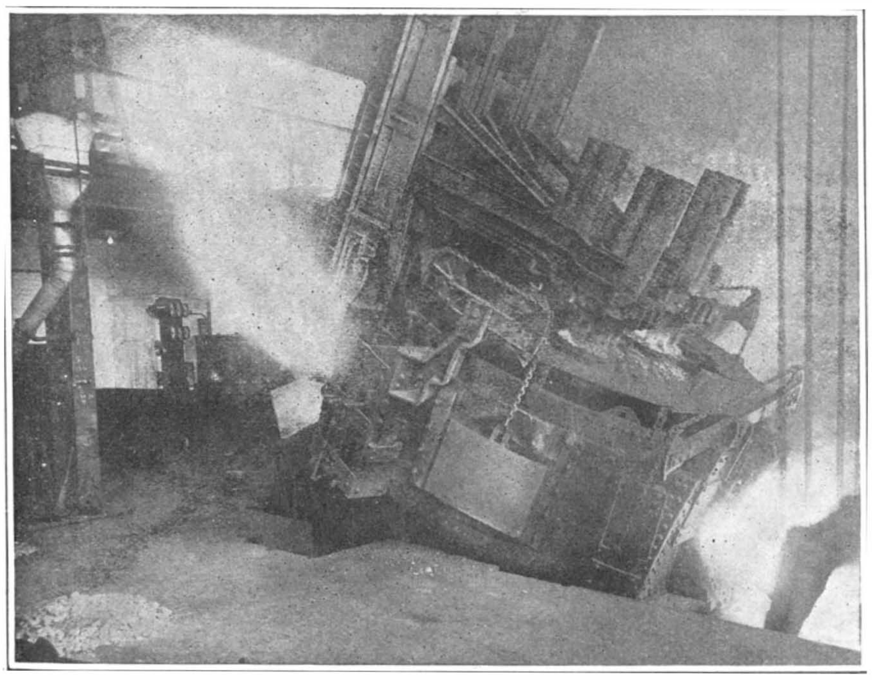
As an important invention which lay fallow for some time may be mentioned Thomson's "electric air drill," the subject of patent 534,730, of February 26th, 1895. The patent is fundamental, and practically covers the form in which electrical energy is now employed for the working of rock drills. In fact, the so-called "electric air drill" is made under this patent.

The oil immersed transformer, as it is commonly employed in the arts to-day, appears in Thomson's patent 428,648 of May 27th, 1890.

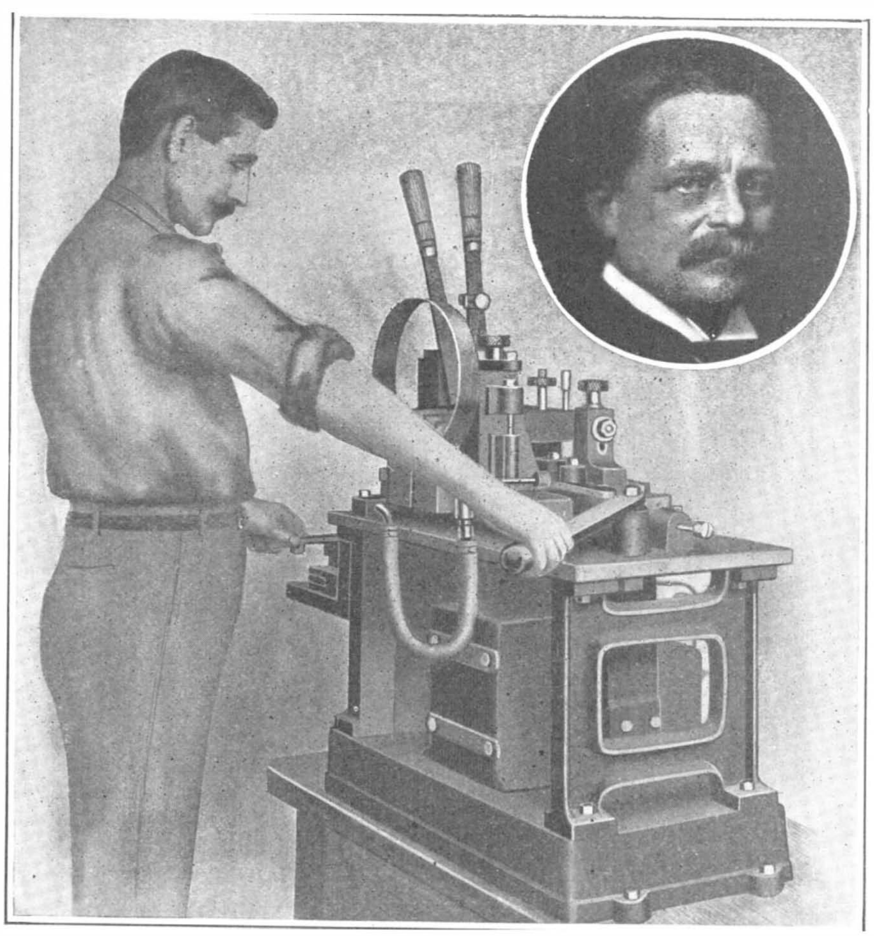
It may be interesting to note that the first endeavor to produce high frequency currents by high frequency dynamos was made about 1890, and a machine produced which gave about 4,000 to 5,000 cycles, and which was capable of being driven at still higher frequencies if necessary. This machine was used in the classic experiments on the effects of high frequencies on animal bodies by Dr. Tatum about 1891 or 1892. The machine itself was an original type of inductor dynamo, so called,



**A typical central station in which Parsons turbines are used to drive electric generators. The portrait is that of the Hon. C. A. Parsons.**

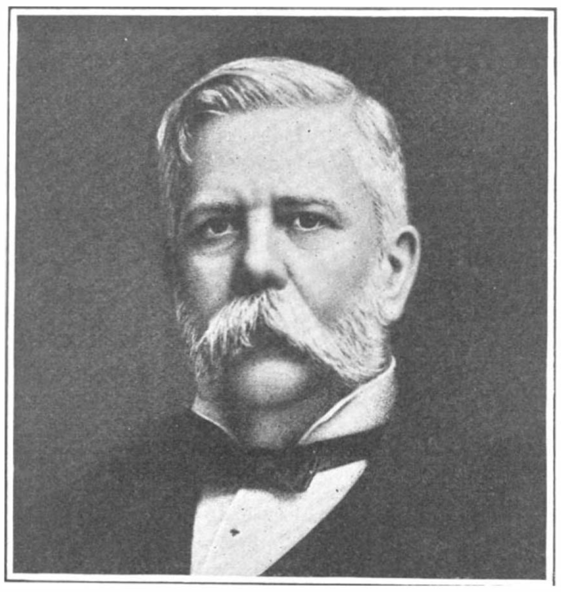


**The electric furnace is radically transforming the steel industry.**



**The electric welder of Elihu Thomson.**

The machine here shown will weld two hundred steel bands in an hour. It takes only a few seconds to make an electric weld. A heavy current of electricity at a low voltage is passed through the abutting ends of the metal pieces to be welded, thereby generating heat locally at the points of contact, while at the same time prssure is applied to force the parts together.



**George Westinghouse, whose invention of the air-brake made modern high-speed railway travel possible.**

the original machine itself being still used in electric testing. It is described in patent 432,655 of July 22nd, 1890.

An important invention bearing on interpole work, now such a decided factor in the construction of dynamos and motors for continuous currents is shown in patent 459,422, filed in 1885 and issued September 15th, 1891. This dynamo appears to be a pioneer invention in that the separation of the series and shunt coils on the field for securing better commutation and at the same time compounding a machine, are found. The principle has been applied in improved forms since then, and, of course, has given superior results.

**Some Work With the Electric Furnace.**

The possibilities of the electrical furnace were never before so brilliantly revealed as in this decade. In 1862 Woehler discovered that water acting on calcium carbide would produce acetylene. The next step was to make calcium carbide cheaply. An early attempt with the electric furnace was that of Henri Moissan (1892), who succeeded in making calcium carbide out of marble and sugar carbon. Then came Thomas L. Willson, to whom the credit is really due of placing the manufacture of calcium carbide upon an industrial basis, which he achieved in 1892 in co-operation with Dickerson.

Paul Héroult constructed the cathode furnace (1887) for uninterrupted operation and thus becomes the founder of the electrometallurgy of aluminium according to the smelting method.

Edward G. Acheson succeeded in 1892 in making silicium carbide in the electric furnace—an abrasive which has been known to the trade as carborundum. He also obtained artificial graphite in the electric furnace.

**Power Generation—The Diesel Engine.**

The year 1893 marks the publication of Rudolf Diesel's "Theory and Construction of a Rational Heat Motor," in which he set forth the principles of the well-known Diesel engine. Diesel engines were first exhibited in 1896 at the Münchner-Austellung für Kleinkraftmaschinen.

In 1887 Gustaf de Laval invented his high-speed steam turbine, in which the potential energy of the high-pressure steam is transformed into kinetic energy in a single stage and imparted to the shaft. In the same year he designed his centrifugal cream separator, which ever since has been widely used in dairies. He seems to have been preceded by Elihu Thomson, who patented the continuous separation of cream from milk by centrifugal force, the first example of a continuously operating centrifugal machine with ducts for the introduction of the new charge, and separate ducts for the exit of the separated constituents. During the life of this patent the centrifugal creamers which were sold in the United States were put out under it, coupled with another of De Laval, but the broad patent was one to which reference has been made, viz., that numbered 239,659.

In 1894 Bénier patented the suction producer-gas plant in which the motor is made to draw its gas from the generator, thus producing a depression in the generator which is filled by air below atmospheric pressure. This air is mixed with steam and forms new gas in passing over the layer of glowing fuel.

The first attempt to use compressed illuminating gas was made by Julius Pintsch in 1891. His system, properly developed, made it possible to illuminate railway trains with gas.

**The Cyanide Process—Artificial Silk.**

The famous McArthur-Forrest cyanide process, which has been of immense importance in gold mining, was brought out in 1887 by Robert William Forrest, William Forrest, and John McArthur. These investigators found that the effect of potassium cyanide depends upon the weakness of the solution. The gold mines of the Transvaal took up the process almost as soon as it was introduced.

The first commercially successful process for making artificial silk was that brought out in 1885 by Chardonnet, who squirted nitro-cellulose under pressure through small holes in water, alcohol, chloroform or the like, the threads congealing at once.

John B. Dunlop, a dentist of Dublin, Ireland, invented the pneumatic tire in 1890, as we know it to-day. He seems to have been quite unaware of Thomson's pioneer work in the same line (1846).

**Artificial Flight—Some Early Experimenters.**

Experiments were made in this decade, which cleared away some of the difficulties that confronted inventors interested in aerial navigation. In 1890 Otto Lilienthal of Berlin began his gliding experiments with a motorless aeroplane of his own design. Simultaneously Langley and Maxim began their experiments. Lilienthal was killed in a machine of his own construction in 1891. Langley in 1896 succeeded in making the first small motor-driven aeroplane which ever flew. He continued his experiments until 1903, when a full-sized machine of his failed to mount into the air because of a defect in the launching apparatus. The machine was successfully flown for a short distance in 1914 by Curtiss. Hiram Maxim's machine was built in 1894. It was of enormous proportions and had a motor steam engine of 360 horse-power. While it might have flown for a short distance, it came to grief because it tore away the guard rails which were intended to hold it on its track.

**Improving the Phonograph.**

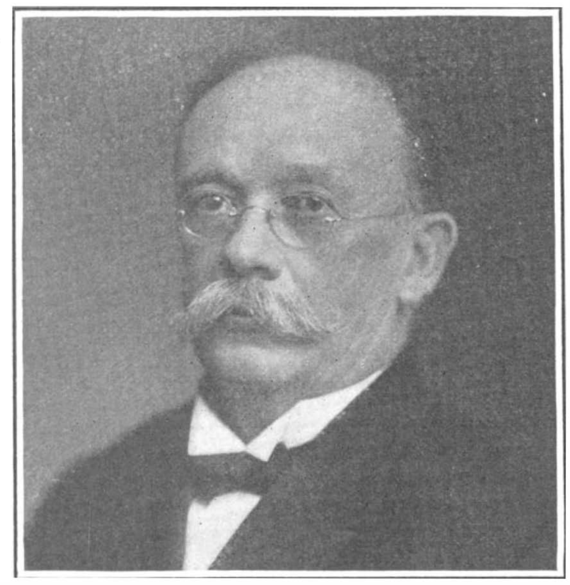
Edison's experimental success with his tinfoil phonograph of 1877 proved the starting point of much valuable investigation in sound production by himself and others. In 1886, Dr. Chichester Bell and Charles Sumner Tainter patented their method of recording and reproducing sounds by engraving a wax or wax-like substance, thus producing records that could be removed from the machine, handled and transported. In 1887, Emile Berliner invented the gramophone or disk graphophone and worked out for practical use the system of duplicating disk records, which has been in use ever since.

**A Record of Achievement in Submarine Invention.**

Goubet of France built several submarine torpedo boats between 1885 and 1890. The novel feature was his propeller, which worked on a universal joint so that it could be changed as to the direction of thrust. It took the place of vertical and horizontal rudders. Prof. Josiah Tuck carried on experiments with his submarine ("Peacemaker") in the Hudson River in 1885, using caustic soda which was introduced into a boiler to generate steam. His boat had a water lock through which a man, clad in a diving suit, could pass. This was the principle that Jules Verne embodied in his imaginary "Nautilus," fondly imagining that the idea was his originally. Several other submarines were built in Europe during this period. The most successful of these was perhaps the "Gymnote" built in France after the designs of Dupuy de Lome and Gustave Zédé.

In 1893 the United States Navy advertised for bids for the construction of a submarine. J. P. Holland, George C. Baker, and Simon Lake handed in plans. Baker's design was based on the performance of a vessel he had experimented with in 1892. Holland submitted plans for a steam vessel of the diving type with horizontal rudders at the stern for changing the inclination of the vessel, as first used by Fulton. Lake submitted a design for a vessel with an inner and outer hull, the inner space to be utilized for water ballast.

**The first successful Maxim machine gun. Beside the gun are Sir Hiram Maxim and the Prince of Wales, later King Edward.**



**Edward Weston, pioneer inventor of dynamos, arcs, and electrical measuring instruments.**

This vessel was designed to be operated submerged on a level keel by the use of hydroplanes; bottom wheels were provided to enable the vessel to be navigated on the water bed itself; air locks were called for to enable the crew to escape in case of danger. Holland secured the Government award because of his previous experience. His vessel, the "Plunger," was not a success, due to her enormous steam installation, which made the interior of the boat unbearably hot, and to her lack of stability. Lake's idea of running along the bottom on wheels—an entirely new conception in the art—received its first demonstration in 1894. This craft was the germ from which later emerged his "Argonaut" (1896-1897), the first submarine to be fitted with an internal combustion engine.

## 1895-1905

This is the decade of the aeroplane and the airship and of wireless telegraphy.

After two years of preliminary study, research and experimenting Count Ferdinand von Zeppelin completed his first great rigid-frame dirigible airship, the pioneer craft of this type. About the same time Santos-Dumont was making sensational flights with airships that could hardly be considered an improvement over those of Tissandier and Renard and Krebs, except that they were driven by modern light gasoline engines which could easily be applied to the dirigible without the exertion of any great inventive ability. Much more important was the work of the Lebaudys, who really created the semi-rigid type. The non-rigid system was developed by von Parseval. The collapsible Parsevals were quickly adopted by the German army and were later improved by Astra-Torres in France.

**The Wright Brothers Invent the Flying Machine.**

But the decade is much more memorable for the actual realization of a flying machine. Octave Chanute continued Lilienthal's gliding experiments with biplanes and multiplanes, his experiments proving that the trussed biplane with some device was necessary to shift the center of air pressure in order to maintain equilibrium. He was the mentor of the Wright Brothers, who began their investigations with similar gliding experiments which culminated in the modern biplane flying machine—a machine driven by a gasoline motor, provided with wing warping devices. For the first time in history, a man having a motor-driven machine flew in 1903 for a distance of 260 meters. In the same decade belong the experiments of Ader; but there is no evidence that his "avion" did more than to rise from the ground and fall back again.

**Marconi and Wireless.**

In 1895 Guglielmo Marconi invented the first practical wireless telegraph apparatus. It contained very little of his own, but in this respect it did not differ from many pioneer inventions. Yet, it was invention in the true sense of the word because a new result was produced with well-known apparatus ingeniously combined. In 1901 Marconi for the first time signaled across the Atlantic Ocean. The development of wireless is traced in the article on Communication in this issue.

The work done with the electrical furnace resulted in the establishment of the aluminium industry. Charles M. Hall discovered in 1886 that natural cryolith is a proper flux and solvent for clay, and with a current derived from seven Grove elements and with carbon electrodes he succeeded in producing the first pieces of aluminium. In 1889 Héroult produced aluminium bronze electrolytically by melting alumina and decomposing the molten mass with the electric current.

F. A. Kjellin, Ernesto Stassano, and Paul Héroult simultaneously and independently discovered about 1900 that if iron is to be reduced from its ores electrically, the iron must not be left too long in the electric arc, as

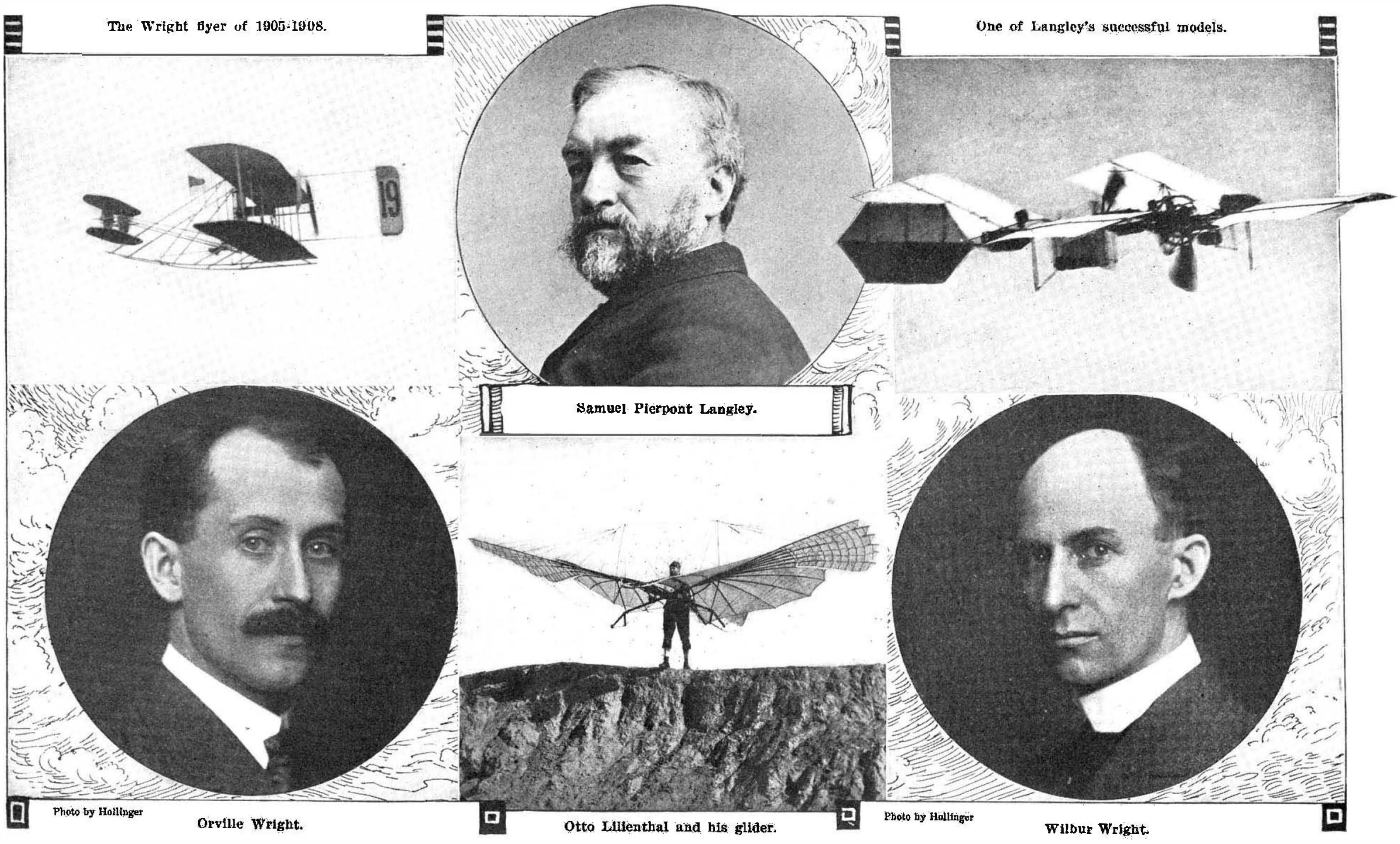
otherwise it will absorb too much carbon and suffer in quality. F. A. Kjellin, accordingly constructed an electric furnace in which this idea was embodied, and on March 18, 1900, obtained the first good quality of electro-steel, free from blowholes. Paul Héroult in the same year built a furnace in LaPraz, in which he also produced very pure iron and steel by smelting the ore in a crucible of refractive material in which the carbon electrode did not actually touch the iron.

In 1897 Hans Goldschmidt of Essen invented the well-known thermit process. Thermit, however, was not introduced commercially until 1899. The modern process of autogenous welding was introduced in 1905 by Fouché, oxygen and acetylene being used in a specially constructed blowpipe.

An attempt to reduce nitrogen from the air electrically was made in Niagara Falls by Bradley and Lovejoy in 1900. This experiment, while not commercially successful, at least served to inspire later work. Thus Christian A. Birkeland and Samuel Eyde built their Norwegian plant in 1903, using electric arcs spread out by magnets so as to obtain a great heating surface.

**The Development in Electrical Engineering.**

There were many other achievements in electrical engineering that deserve mention, but only a few can here be listed. In 1898 appeared the telegraphone or


The Wright flyer of 1905-1908.
One of Langley's successful models.
Samuel Pierpont Langley.
Photo by Hollinger
Orville Wright.
Otto Lilienthal and his glider.
Photo by Hollinger
Wilbur Wright.

**Pioneers in artificial flight.**

telephonograph, the invention of Poulsen and Pedersen, two Danish electrical engineers. The instrument is a beautiful combination of the telephone and phonograph, sound being magnetically recorded upon steel disks or wires and reproduced by means of telephone apparatus.

In 1898 Hermann Theodor Simon of Goettingen studied the superposition of alternating upon direct currents, and invented the singing arc lamp, which may be regarded as a kind of radio-phonic instrument.

The so-called "musical arc" has been variously called the Duddell and the Poulsen singing arc. This was a discovery made by Prof. Elihu Thomson years before the others had entered the field, and it forms the subject of a patent No. 500,630, filed July 18th, 1892, and issued July 4th, 1893. It covered broadly the shunting of an electric discharge apparatus such as an arc by inductance and capacity for producing automatically high frequency waves of a continuous nature. It was, in fact, the first apparatus of the kind which would give that result, the Duddell musical arc being practically the same thing, and the Poulsen arc being a slight modification.

In 1901, Frank J. Sprague, the well-known American electrical engineer, invented his famous multiple unit system of control for electric railways. In this system all cars are provided with two motors, and so connected by Sprague's coupling devices that all the motors of the train are switched in and out by a single motorman at the head of the train. The system was put into service on the south side elevated railway of Chicago under forfeiture contract. The multiple unit system is the sole dependence of the roads in New York and Boston. Sprague's fundamental and basic patent on this system contains nearly three hundred claims.

In 1902 J. F. Stone's system of electric train lighting was introduced in the United States. In this system the current is delivered by an auxiliary battery to which the car rod lamps are connected. A regulating apparatus of special design renders it possible to supply uniform current, whatever the speed of the train may be. Stone's system was improved in 1903 by Aichele by the use of a new regulating system which eliminates the need of any attention whatever on the part of the train crew.

B. G. Lamme of the Westinghouse Manufacturing Company brought out the high tension motor for single phase alternating current in 1902. The motor was soon introduced on electric railways.

The Swedish engineer, Jungner, invented the alkaline nickel-iron storage battery, but it remained for Edison (1903) to bring the battery to commercial perfection. Edison made his cell of sheet metal instead of hard rubber and filled the plates with hydraulically pressed briquettes, composed of iron and graphite for the positive plate and nickel and graphite for the negative plate. He provided outlets for the escape of gases as well as inlets for electrolyte.

Edison worked hard during this decade on the motion picture camera and projector and did much to give us the modern motion picture industry. He brought his magnetic iron ore concentrator to a high state of efficiency. Unable to utilize the plant commercially because of the Mesaba ores which then began to be worked on a cheap scale, he applied part of his apparatus in developing his Portland cement process.

**Thermodynamic Developments.**

The steam turbine was markedly developed during this period. C. G. Curtis invented in 1896 his multi-stage pressure turbine. A. Rateau in 1898 constructed his multi-stage pressure turbine. Zoelly in 1902 constructed a multi-stage pressure turbine which is essentially similar in principle to that of Rateau. A. Rateau invented the first turbo-compressor in 1900 and a turbo-pump in 1902.

The principle of utilizing internal work in liquifying air as well as the counter-current principle of refrigeration was discovered in 1898 by Karl P. G. Linde. The outgoing air was used to cool off the air still contained within the apparatus so as to produce a cumulative refrigerative effect. He built a refrigerating machine on this principle with which very low temperatures were reached.

In 1898 Ochelhäuser of Dessau installed an engine in the Hörde Iron Works for the conversion of blast furnaces into mechanical energy; the engine itself was patented in 1896, and was a two-cycle double piston engine. The Körting blast furnace gas engine was brought out in 1898. Cockerill of Seraing, Belgium, introduced a four-cycle blast furnace gas engine in 1899. From this the two-cylinder blast furnace gas engine of the Nürnberger Maschninenbau-Aktiengesellschaft was evolved.

In 1904 James A. Gailey brought out his dry blast process for the production of iron and steel. He solved the problem of drying the air by freezing out the water. Although he encountered great difficulties in introducing his process it is now recognized as one of the most important contributions to the steel and iron makers art, effecting as it does remarkable economies.

The American iron industry suffered a great change in this decade. The Mesaba ores were being introduced. Since the blast furnaces were far removed from the Lake Superior beds cheap handling was an essential, a consideration met by Brown's bridge cranes, cableways, and trolleys. A radical departure was made in ore handling when G. H. Hulett in 1898 invented the automatic ore unloader bearing his name. It did away with the shovelful as the unit of bulk and substituted the grab bucket of ten tons capacity. The entire machine was made to travel along the dock to reach all hatches without shifting the boat. This machine reduced the cost of handling ore from nineteen cents a ton to less than six cents a ton. While this machine was being developed F. E. Hulett designed and patented an excavating bucket that could be controlled entirely by ropes.

**Industrial Chemistry.**

In 1897 Karl Engler made exhaustive researches on the decomposition of hydrocarbons when subjected to heat and pressure. Thanks to him much light was shed upon chemical reactions, which take place when oil is cracked. Most cracking processes are based upon the methods disclosed in patents taken out in 1890 by Dewar and Redwood. The Dewar and Redwood process is in turn an outgrowth of the Krey high-pressure distillation process of 1887.

The method of hydrogenating soft fats and oils, whereby it is possible to convert vegetable oils into substitutes of lard and some fats into hard fats of greater commercial value was discovered in 1902 by P. Sabatier and J. B. Senderens.

The separation of ores by oils was introduced in 1902 by W. Elmore. The ground ore mixed with the residue of petroleum distillation was placed in rotating cylinders so that oil and pyrites are intimately mixed. The oil is then centrifugally separated.

In 1899 William Draper constructed a loom with automatic shuttle-changing mechanism, the first practical success of its type, and the result of ten years' experi-

(Concluded on page 550.)

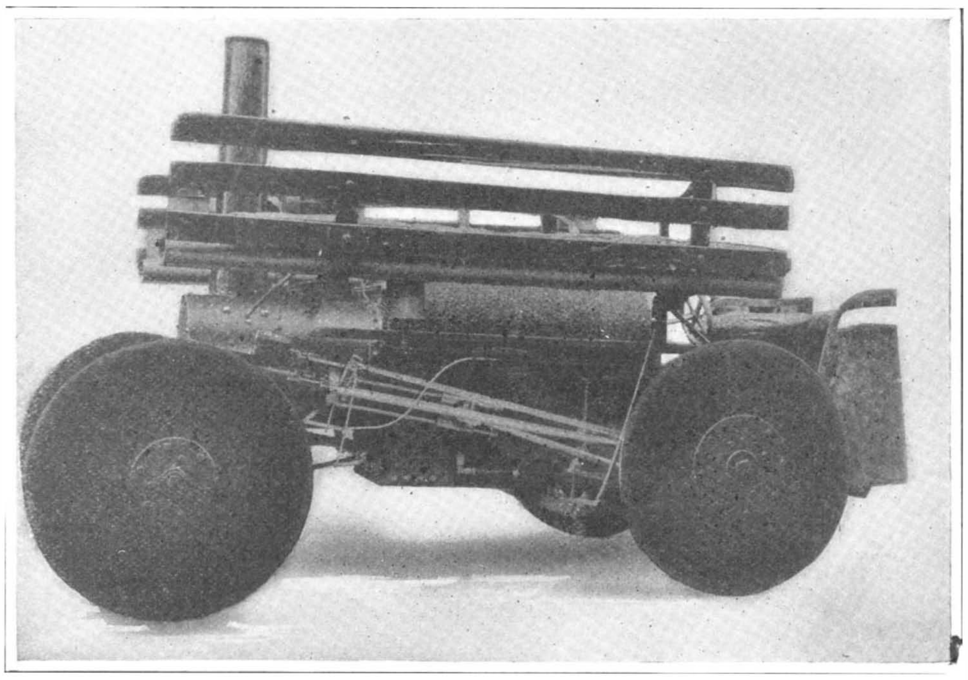
# The Rise of the Automobile

## From the Snorting Road Locomotive to the Swift Noiseless Car of To-day

IT would hardly seem necessary to turn back seventy years to trace the history of the automobile. Surely any full-grown man can recall his first view of a chugging horseless carriage. And yet, in 1845, when the SCIENTIFIC AMERICAN was established, the power-driven road vehicle was an old story. Joseph Cugnot of France and his three-wheeled steam carriage that actually ran for a short distance and then upset because it was too top-heavy to take a sharp turn at three miles an hour, was even at that early day a historic event seventy-five years old. It was in 1802 that Richard Trevithick, in England, was ruled off the highways for joy-riding when he ran into a fence at the frightful speed of 10 miles per hour and ripped off several palings.

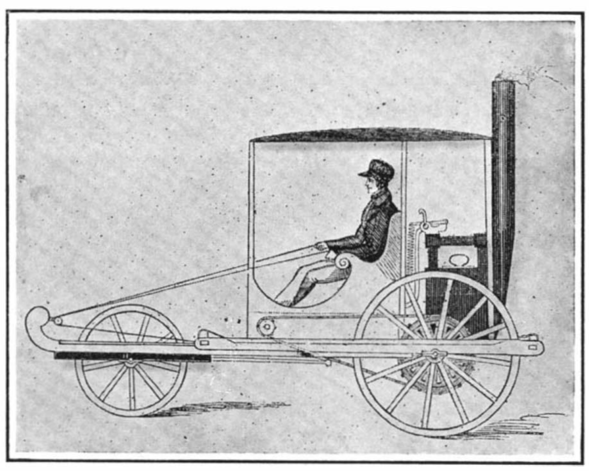
Of course, the automobile was an old story, for it was the father of the locomotive. The idea of running locomotives on rails was an afterthought. The first of them were run on the common highways, and we owe to these early machines the development of many of the essentials of the modern motor vehicle. The use of stub steering axles in place of the fifth wheel dates back to 1819. A transmission gear with two speeds appeared on a steam carriage in 1821 and the same car was fitted with a condenser similar to the early type of radiators on gasoline automobiles. In 1825 a 10 horse-power engine was developed, using a *flash boiler*. A power-driven fan—not for cooling the engine, of course, but for furnishing the furnace with forced draught—appeared in the early thirties, and at about this time the clutch was developed. The differential was used in 1840, although it had been known as a mechanical movement for many years prior to that time, and finally, in 1845, came the invention of the pneumatic tire. This was a canvas rubber inner tube incased in a leather shoe or outer tube.

Thus we see that when the SCIENTIFIC AMERICAN came into being the automobile, as a pleasure vehicle, had had a very thorough trying out, but it had been found wanting, and, by the public at large, had been relegated to a place in the vast museum of impractical inventions. Indeed, England had already begun its oppression of the motor vehicle by burdening it with excessive tolls and restrictions, that grew increasingly irksome, until, eventually, it was practically barred from the highways by an act forbidding a speed of more than four miles per hour and requiring that each power-driven vehicle be preceded by a man waving a red flag. Not until 1896 was this foolish law repealed, and it was responsible for the paucity of British contributions to the development of the automobile in the earlier days of its present era. However, in marked contrast to the spirit of the times, the SCIENTIFIC AMERICAN took a keen interest in power-driven vehicles and tried to encourage and promote them. We find even in one of its earliest numbers—that of October 2nd, 1845—a front page illustration and description of a steam carriage for common roads which was steered with a pair of reins. Undoubtedly the most important contribution to the motor vehicle during the early history of the SCIENTIFIC AMERICAN was that of Richard Dudgeon. In 1855 he and two other engineers were discussing the feasibility of driving a road vehicle with power, and made a compact that each one of them would undertake the task. The other two inventors failed to produce anything of value, but Richard Dudgeon's machine was a success. It made frequent trips about the country at high speed. Forty miles an hour is the record it hung up, and frequently it made speeds of 35 miles per hour. Unfortunately, it was destroyed while on exhibition, in the Crystal Palace fire of 1858. A second machine was built by Dudgeon in 1860. Both of these machines were virtually locomotives adapted for road travel. A power vehicle of much more modern appearance was developed by the House brothers in 1866, and it attained a speed of 30 miles per hour. About this time the steam fire engine made its appearance, and steam began to be used more and more for traction purposes.



**Richard Dudgeon's steam road car, built in 1860.**

The original machine, of which this is a duplicate, was constructed in 1855.



**A steam vehicle steered with reins.**

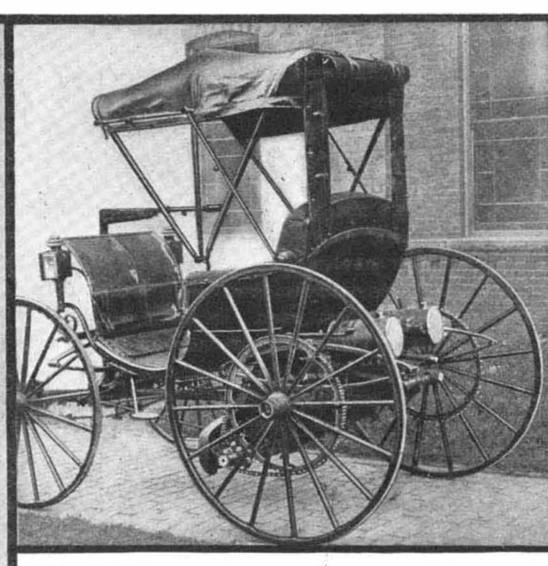
From the SCIENTIFIC AMERICAN of October 2nd, 1845.

In England, during the same period, the steam vehicle was used for commercial transportation purposes. Steam stages came to be quite common. In 1861 the famous "fly-by-night" was produced and it used to thunder through the villages after dark at speeds of 10 and 15 miles per hour. So frequently was the owner of the car arrested for disturbing the neighborhood that eventually he and his crew had to put on firemen's helmets and coats and equip their machines with fire hose and buckets so that they could fool the constables into thinking that they had a legitimate reason for driving out at all hours of the night.

All this time the automobile was merely waiting for the proper type of engine to make it a popular success. One of the earliest uses of steam produced with gasoline fuel was that of R. E. Olds, who in 1887 built a buggy that was driven by a steam engine. However, the steam boiler was of the tubular type. It was in 1889 that Serpollet, in France, revived the flash boiler principle and gave the steam carriage a fresh impetus that has lasted to the present day. At first even he used coal fuel, but later he changed this to kerosene, and eventually gasoline was the accepted fuel. So successful did this type of boiler prove that it made steam a very close competitor of gasoline for many years. The earliest American steam machine of the present era was that built by the Stanley brothers in 1897. This machine is still being manufactured despite the fact that others who started out with the steam drive have given it up for the internal combustion engine.

The history of the gas vehicle properly starts with 1860, when Lenoir in France patented a vehicle driven by an explosive engine. In this country the first man was George B. Selden, who began experimenting with power-driven vehicles in 1874. Realizing that the steam engine was entirely too heavy for his purpose, he endeavored to produce a gas engine. At first he generated gas by burning liquid fuel, and tried to utilize this gas in the cylinder of the engine just as steam is used. But he soon found that this was not practical, and finally decided that the combustion of the gases should take place in the cylinder itself. About this time he came across the work of Brayton, who was building internal combustion engines for boats. Brayton's work covers the years from 1870 to 1885, and he did much pioneer labor on a type of engine that is now obsolete. Brayton's idea was to compress the gas and ignite it as a jet in the cylinder. Having built a model and having satisfied himself that he was on the right track, Selden applied for a patent in 1879. But although Selden was undoubtedly the first man in this country to invent a gasoline automobile, he was not a pioneer, for he did

**The Stanley brothers in their first car. The pioneer of modern American steam vehicles.**



**The first successful American gasoline car; built by Duryea in 1892-1893.**

**Charles Duryea in his famous machine that won important races here and abroad in 1895 and 1896.**

not show the way to others. Instead, he kept his patent pending in the Patent Office by various means for sixteen years. Not until 1895 was the patent issued and the public apprised of the early work of George Selden, by which time the automobile had been well established and was being manufactured here and abroad. The patent added nothing to the knowledge that other investigators had acquired by the labor of their own hands. Instead of a public benefit it proved a public loss; it served merely as a pretext for exacting tribute from automobile manufacturers.

In 1905, ten years after the issue of the patent and a quarter of a century after its inception, was the first and only Selden car built, and then its only purpose was to prove the validity of the patent. Finally, in 1911, when the patent had but a few more months to run, the decision was rendered that the modern car is not an infringement of the Selden patent, because it does not use the Brayton type of engine, but that of Otto. The latter dates back to 1878, and hence was known at the time that Selden filed his application.

About the time that Selden was making his early experiments, Siegfried Markus in Austria built a gasoline-propelled vehicle which is still on exhibition in Vienna and bears date of 1877. However, there is no evidence that it ever ran.

The real father of the modern automobile was Gottlieb Daimler, who, in 1884, patented a road vehicle driven by a high-speed internal combustion engine of four-cycle type. A year later Karl Benz, also of Germany, produced a vehicle driven by an internal combustion engine. These, the first steps in the development of the modern automobile, took place in Germany. At first progress was slow, but inside of ten years the motor-propelled vehicle had proved itself of sufficient popular interest to cause the *Petit Journal* to offer a prize for an automobile race from Paris to Rouen. This was in 1894, and it proved a great success. The next year another race was held between Paris and Bordeaux, in which there were sixty-six entrants.

In the meantime America was not standing still. Indeed, in the earliest days of the present era of automobiling this country was very proudly represented. Despite the prior invention of Selden, we may point to Charles E. Duryea as the father of the American automobile. He started out at first with the idea of building a flying machine. It was in 1886, at the Columbus (Ohio) State Fair, that he came across a gas engine. It used gasoline for fuel and had electric ignition, using twelve wet cells. Mr. Duryea tells us it weighed a ton at least and was as big as a dinner table, while the gas tank, which was the equivalent of the carbureter, was as big as a washtub. Beautiful as this machine looked to Mr. Duryea, it was evidently not adapted for flying, but it occurred to him that it would make a good horse, and so he decided to build a motor-propelled road vehicle. Realizing that the public was hardly ready for such a machine, he did not actually start work until several years later. It was in the fall of 1891 that he began the construction on his first motor carriage. The following spring it was completed and actually ran. This encouraged the building of a second and a third machine. The last was a big success. Although Lenoir in 1862 used a jump spark, all the other foreign machines up to 1895, and some as late as 1900, used the hot tube ignition. Charles Duryea, with his brother, Frank Duryea, however, used spark ignition, and they developed the spray carbureter in the very first machine, while the foreign machines for five or ten years longer used a surface or bubbling device. Even the bloc motor was used by Duryea in 1894 and the throttle control was developed in 1895-1896. But we must drop this pioneer for the time being and consider several others.

Elwood Haynes started work upon a power-driven machine in 1893. He used a two-cycle marine-type gasoline engine that weighed 180 pounds and gave only one brake horse-power. When the machine arrived it was set up in Mr. Haynes's kitchen and put to a test. It operated with such speed and vibration as to pull itself from its attachment to the floor. This showed Mr. Haynes that he would have to build a vehicle of much heavier construction than he had at first contemplated. It was not until July 4th, 1894, that the machine was ready for test. Then, because of the crowds that gathered around the curious vehicle, it had to be hauled three miles into the country behind a horse and carriage. But it came back under its own power at the goodly speed of 7 miles an hour.

Another pioneer who began in 1893 is Alexander Winton, but his first product was a motor bicycle. It was not until 1895 that the first Winton gasoline machine was completed, and it was a curious looking car, being designed for four passengers, the two seats being placed back to back. This machine made many successful runs in Cleveland during that year. In the meantime, R. E. Olds was not idle. As previously stated, he built his first machine in 1887. This, however, was a three-wheeled steam machine, although gasoline was used for fuel. A four-wheeled steamer was built after that. Finally, in 1894, he started the construction of a gasoline vehicle.

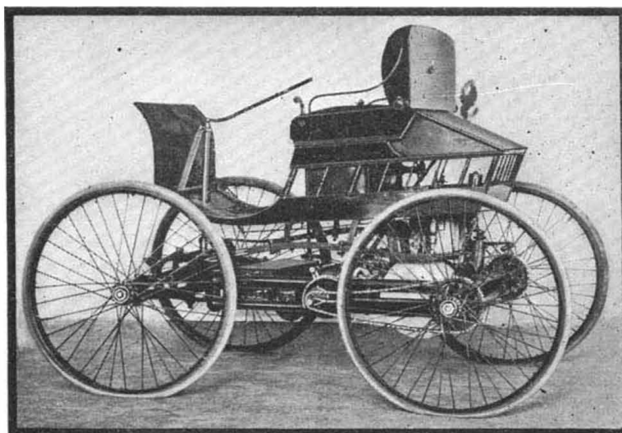
In the same year two other pioneers appeared. Charles B. King, a manufacturer of marine gasoline engines, placed one of his engines in his buggy and gave his horse a holiday while he chugged about Detroit in his motorcar. Henry Ford, who built a steam vehicle in 1892, started a gasoline machine in 1894. But he was not building cars as rapidly then as he is now. Not until 1896 was that machine completed. In the same year Frank B. Stearns completed his first automobile and also built two others, which were sold.

America in the early days was no more kind to the horseless carriage than it has been to the flying machine. For the first ten years only two patrons of the automobile appeared. Inspired by the successful races abroad, and endeavoring to stimulate interest here, the Chicago *Times-Herald* offered prizes amounting to $5,000 for a 92-mile race to be held in and about Chicago on the Fourth of July, 1895. This generous offer was enough to take the breath away from American inventors. They were totally unprepared for it, and time and time again the race had to be postponed because, although on paper there were enough entrants, not enough machines materialized to make it a real race. Not until November 2nd was a contest held, and this was merely a consolation race, because there were but two competitors, namely, one Duryea machine and an imported Benz car. Unfortunately the Duryea machine, although leading, was purposely ditched, to avoid collision with a farm wagon that made a false turn on the course, and the German car struggled on alone to the finish. Finally, Thanksgiving Day was set for the real race, and five cars participated. Of these, two were Benz cars and one a Roger from France, while America was represented by a Duryea and a Sturges electric car. The course was a most difficult one because a snowstorm had covered the ground with twelve inches of snow. One of the entrants was the Haynes car, which won a prize for the best design of motor, but did not actually engage in the race because of an accident due to skidding on the ice just before the start. Only two of the contestants finished this race, and they were the ones that had engaged in the consolation race a few weeks before. This time, however, the Duryea car won easily, leaving the Benz far in the rear.

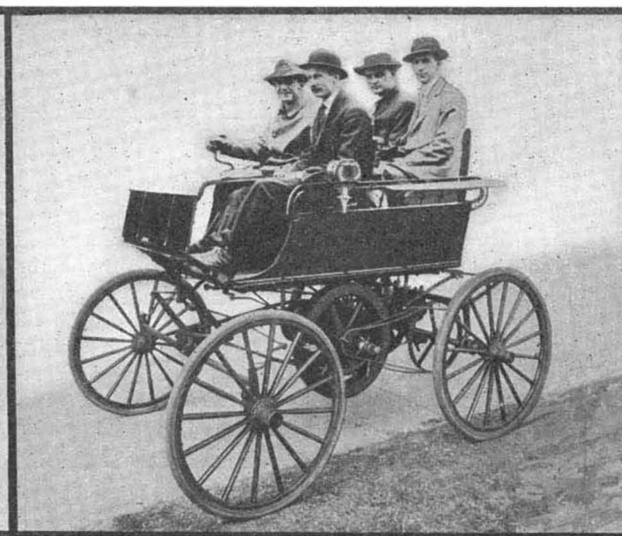
The second big race was held the following year on Decoration Day. The prizes, amounting to $3,000, were offered by Mr. John Brisben Walker of the *Cosmopolitan Magazine*. The course was from City Hall, New York, to Irvington-on-the-Hudson and return. Four Duryeas were entered in this race and they won every prize.

It was in the fall of 1896 that the English Parliament repealed the restrictions to motor traffic on British highways, and the same day, November 14th, a race was held in celebration of this event, between London and Brighton, a distance of 52 miles. There were entrants from all countries, France and Germany being well represented. It was naturally expected that the winners of the Paris-Bordeaux contest would sweep

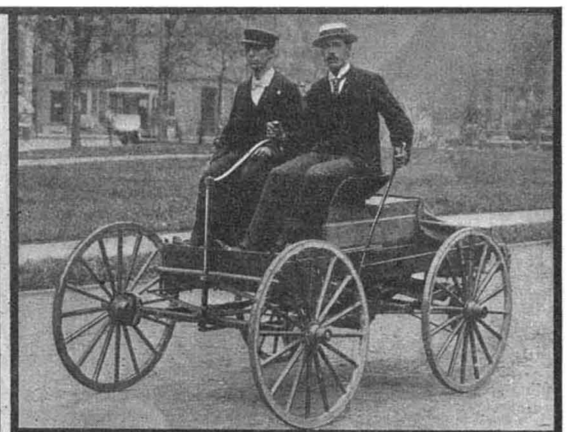
(*Concluded on page 532.*)



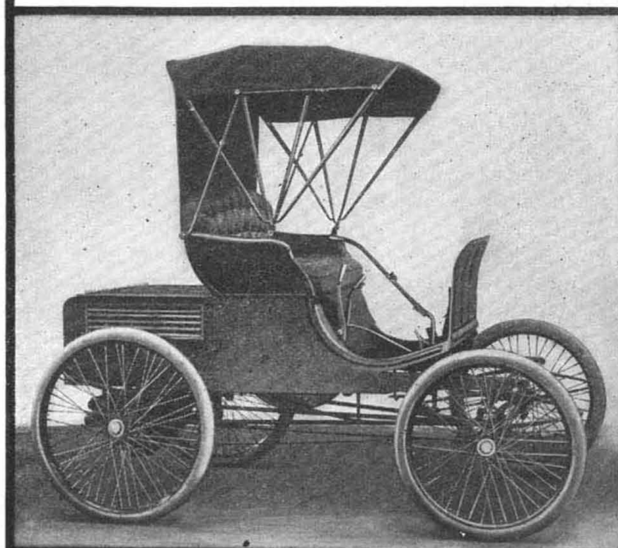
**The first Haynes car that ran in 1894 and won a prize for design in 1895.**



**R. E. Olds's first departure from steam to gasoline. Begun in 1894 and finished late in 1895.**

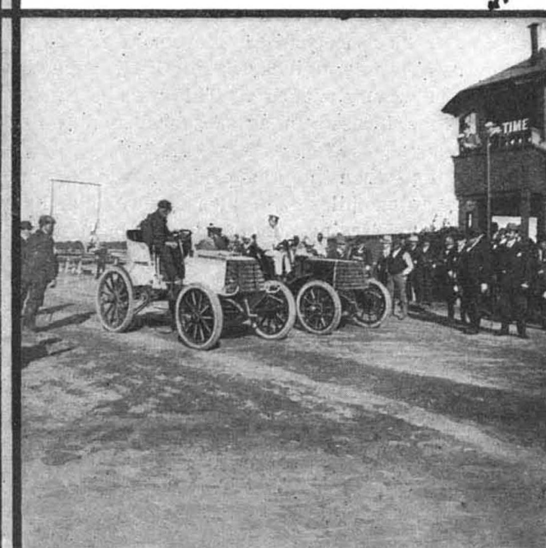


**Charles B. King steering his power buggy driven by a marine engine (1894).**



**First Winton car sold (1898). Note the pins to prevent boys from stealing a ride.**

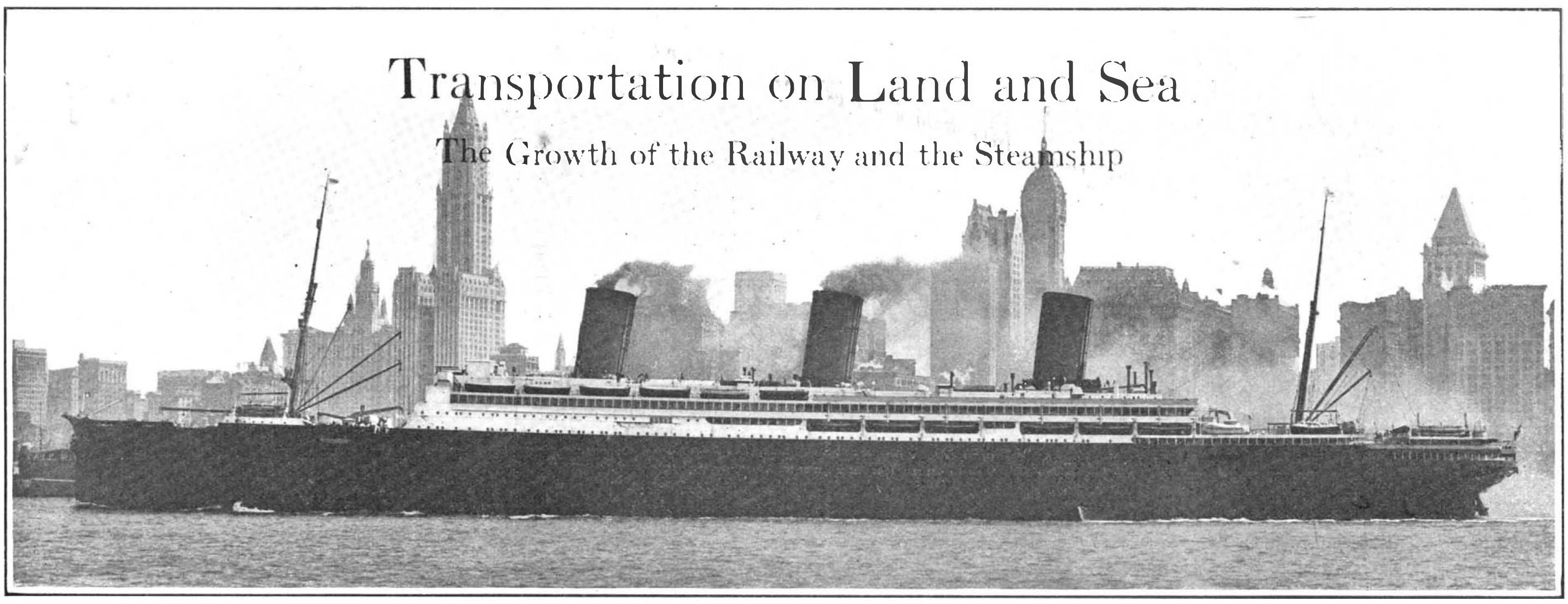
**The car of F. B. Stearns, built in 1896, and still in good running condition.**



**Race at Guttenberg, N. J., in 1900. Two Panhard-Levassor machines competing.**

# Transportation on Land and Sea

## The Growth of the Railway and the Steamship



The nine hundred and nine foot "Imperator" steaming up the Hudson River.

**Development of the Transatlantic Steamship.**

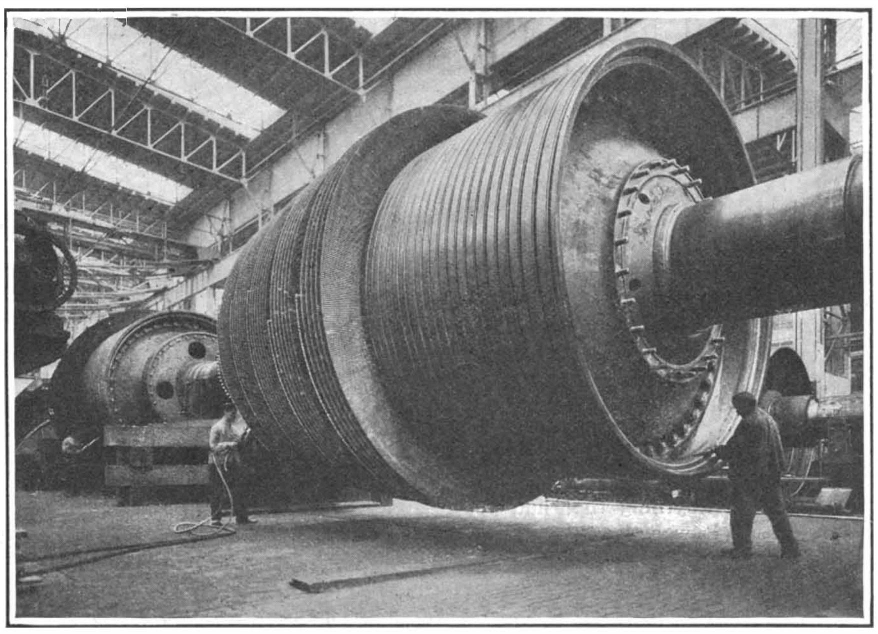
ON July 4th, in the year 1840, a little wooden side-wheel steamer cast loose from her dock at Liverpool, and fourteen days and eight hours later steamed into Boston harbor amid the acclamations of the assembled citizens and every manifestation of civic pride and rejoicing. The little craft was the "Britannia," the first of the since-famous Cunard Line, and the first steamer to sail under regular government contract for the conveyance of the transatlantic mail. In the accompanying diagram, showing the growth of the transatlantic steamship during the seventy years covered by the life of the SCIENTIFIC AMERICAN, we commence with the "Britannia" for the reason that, although she was not by any means the first steamship to cross the Atlantic, she was the first to do so on a regular schedule.

The "Britannia" was a wooden side-wheel steamer 215 feet long, 34 feet 4 inches in beam, and of 1,731 tons displacement. Her engines, of 740 horse-power, gave her an average sea speed of 8.5 knots. She was one of four sister steamships built under a contract with the British government, by which the company was to provide four steamers and dispatch one of them from Liverpool for Halifax and Boston, on the 4th and 19th of every month from March to October, and on the 4th of each of the four winter months. At the date of the birth of the SCIENTIFIC AMERICAN, therefore, these ships were representative of the Atlantic steamship of that day; and the illustration which we give of the "Aquitania" of 1914, carrying all four of these little craft on her boat deck, which she would be quite capable of doing, may be taken as an excellent epitome of the past seventy years of development. The "Aquitania" is 901 feet long by 97 feet broad and is 92 feet deep from keel to topmost deck. Her displacement is something over 50,000 tons, and with 60,000 horse-power she has made a speed of 23.5 knots.

Mention should be made of the fact that in the first decade covered by the present review, that great engineer, Brunel, built the first iron steamship, also named "Britannia," in which he anticipated many of the improvements which were to come in later years. Brunel's "Britannia" had a double bottom and transverse and longitudinal bulkheads. She was the first ship to employ the screw propeller, and in other details in addition to these she was pre-eminently the pioneer of the modern ocean liner.

The first American steamer to be built for the Atlantic trade was the "United States," constructed in New York by William H. Webb for the Black Ball Line of packet ships. She made her first voyage to Liverpool in 1847 and it lasted thirteen days. She was a wooden ship of 2,000 tons burden, 256 feet long by 50 feet beam.

In 1850 the United States entered the lists against the Cunard Company by putting in service four boats of the Collins Line, vessels which in size, speed, luxurious accommodations and general excellence of finish were in advance of anything afloat at that time. The "Pacific" of this line was the first ship to make the passage from New York to Liverpool in less than ten days, which she did during a passage in May, 1861, bringing the time down to nine days, twenty hours, sixteen minutes. In February of the next year the "Arctic" crossed in nine days, seventeen hours, twelve minutes. The same company in 1855 launched the "Adriatic," a vessel of 4,144 tons.



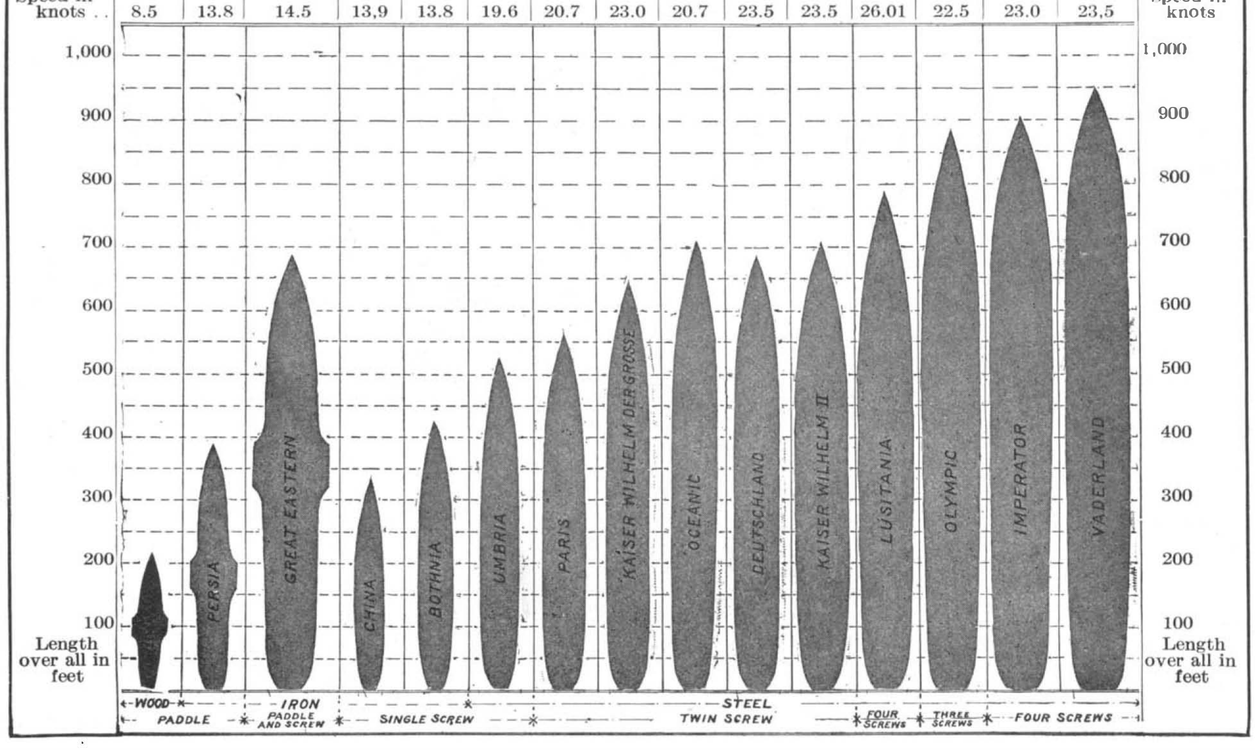
The rotor of one of the low-pressure turbines of the "Imperator." Diameter, 18 feet.

To meet the successful competition of the Collins Line, the Cunard Company in 1855 launched the "Persia," of 3,870 tons and about 14 knots speed. She was a paddle steamer and was built throughout of iron.

We have introduced into our diagram a phenomenal vessel which, strictly speaking, should not have any place in the history of the development of the transatlantic mail steamer, for the reason that she was never run on any regular schedule under government contract. We refer to the "Great Eastern," and she is shown in order to emphasize the fact that she was fifty years ahead of her time and, in fact, anticipated in point of size such vessels as the modern "Oceanic" and "Kaiser Wilhelm II."

The "Great Eastern" was a splendidly built ship, and cost no less than $3,650,000, an enormous sum in those days. She was 692 feet long on deck, 118 feet broad over the paddle boxes, and she displaced 28,000 tons on her ordinary draft, although on a draft of 30 feet she would displace 32,160 tons. She was driven both by paddle wheels and by a screw propeller. Her maiden trip was made from Liverpool to New York in 1860. Her highest speed during the trip was 14½ knots an hour and the longest day's run 333 miles. The ship was the safest passenger vessel ever built, including even those of the present day. She had a complete double hull, extending to 10 feet above the water-line, where she carried a water-tight deck, and she was divided longitudinally and

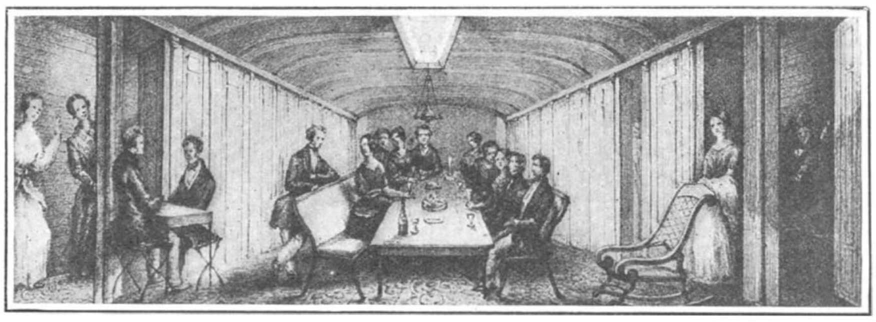
| Date | 1840 | 1855 | 1858 | 1862 | 1874 | 1884 | 1889 | 1897 | 1899 | 1900 | 1903 | 1906 | 1911 | 1913 | 1914 | Date |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Length on deck | 215′ | 385′ | 692′ | 337′ | 435′ | 525′ | 560′ | 649′ | 705′ | 686′ | 707′ | 790′ | 883′ | 909′ | 950′ | Length on deck |
| Beam | 34′ 4″ | 45′ 3″ | 83′ | 40′ 5″ | 42′ 3″ | 57′ 3″ | 63′ | 66′ | 68′ | 67′ | 72′ | 88′ | 92′ 6″ | 98′ | 100′ | Beam |
| Displacement in tons | 1,731 | 4,950 | 28,000 | 3,808 | 6,834 | 12,190 | 15,000 | 21,000 | 29,000 | 23,500 | 27,000 | 44,500 | 52,000 | 54,000 | 58,000 | Displacement in tons |
| H. P. | 740 | 2.900 | 8,000 | 2,250 | 3,250 | 14,500 | 20,000 | 31,000 | 28,000 | 37,500 | 38,000 | 70,000 | 60,000 | 70,000 | 80,000 | H. P. |
| Speed in knots | 8.5 | 13.8 | 14.5 | 13,9 | 13.8 | 19.6 | 20.7 | 23.0 | 20.7 | 23.5 | 23.5 | 26.01 | 22.5 | 23.0 | 23,5 | Speed in knots |




Growth of the transatlantic steamship from 1845 to 1915.

transversely by bulkheads which gave her a total of fifty compartments that were water-tight. She was many years ahead of the development of passenger and freight traffic, and could never secure sufficient of these to render her a paying investment. She proved invaluable, however, by successfully laying the first Atlantic cable in 1866, and she laid two others in 1873 and 1874. Finally, in 1888, she was sold and broken up at Liverpool.

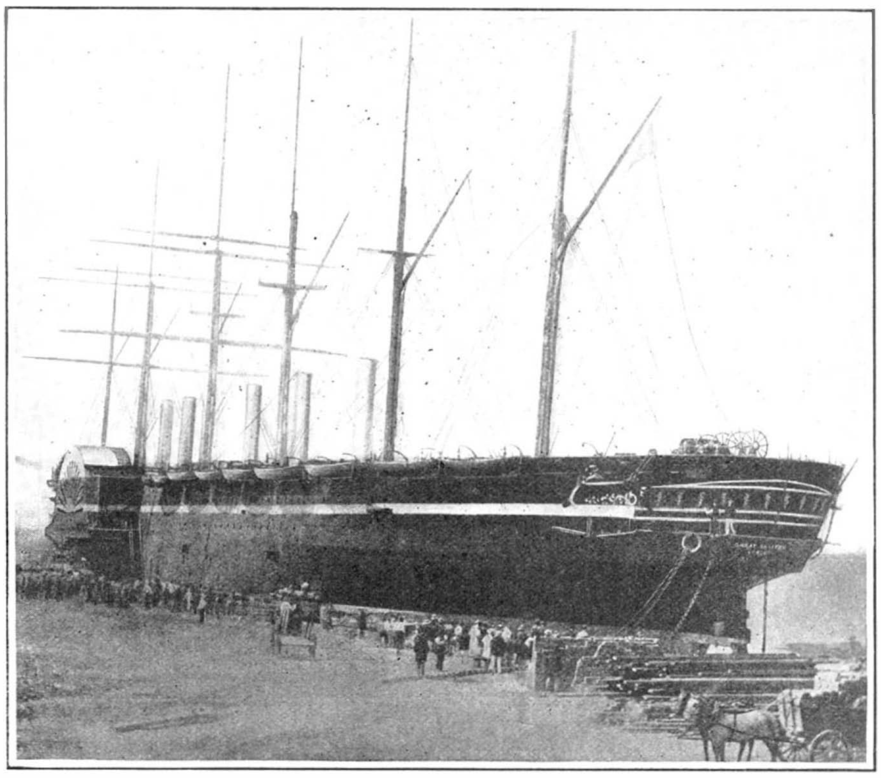
For several years the Inman, now the American Line, had been using the screw propeller, and in 1862 the Cunard Company launched the screw-propelled "China," a vessel 337 feet long, whose average transatlantic speed was 13.9 knots.



**Dining-room and saloon of a steamer fifty years ago.**

The first transatlantic liner of the North German Lloyd—or rather of its predecessor, the Ocean S. S. Navigation Company—was the "Washington," considered in its day a marine wonder. The cabins were entered from a central hall, about ten feet wide. This hall took the place of the dining-room and saloon of to-day. At meal time a table, running the length of the hall, was placed in position and about it the dozen first-class passengers partook of their repast. Upon its completion the table was folded up and then the "dining room" again became the "saloon." The records show that on her initial trip this "Washington" carried one first cabin and ninety-three steerage passengers!

About this time the compound engine, with its higher steam pressure and superior economy, began to make its appearance, and simultaneously came in that era of long and narrow ships which was destined to play such an important part in the history of the steamship. The "Bothnia," 1874, was a compound, single-screw vessel, which was typical of the ships of that day. With a length of 435 feet, her beam was only 42 feet 3 inches—a ratio of length to beam of over one to ten. Her speed was about the same as that of the "China."



**Photograph showing the "Great Eastern" at the foot of Canal Street, North River, New York, in 1860.**

Within the next ten years there was a steady increase in dimensions, and in 1884 there appeared in service the "Umbria" and "Etruria," the crack ships of their day, 525 feet in length and displacing 12,190 tons. They were single-screw vessels, and their engines, the largest single-screw engines ever put into a steamship, indicated 14,500 horse-power. The "Etruria" maintained a speed of 19.6 knots for the whole trip across the Atlantic and she was the first transatlantic steamship to make the passage in less than six days.

The credit for producing the first twin-screw transatlantic steamers, the "City of Paris" and the "City of New York," is due to the Inman and International Line. These remarkably fine vessels, which are still in service, are 560 feet in length, 63 feet in beam, and they displace 15,000 tons. The "City of Paris" made the transatlantic passage at an average speed of 20.7 knots. The two vessels introduced many excellent features, one being their great beam in proportion to their length, and another the remarkably handsome dining saloon, placed forward of the engines, a disposition now universally followed.

In 1893 the Cunard Company took the leading position with two steamships which were the first to exceed 600 feet in length, the "Lucania" and "Campania." They were designed to be considerably the fastest vessels afloat, and to this end engines of 30,000 horse-power were provided. The "Lucania" was the first ship to cross the Atlantic at a speed of over 22 knots.

The North German Lloyd Company made a notable entry into the competition for the blue ribbon of the Atlantic by setting afloat in 1897 the "Kaiser Wilhelm der Grosse," 649 feet long, and of 20,000 tons displacement. She was a very handsome ship, and she was the first transatlantic liner to have four smokestacks.

In 1899 the White Star Company, whose vessels have always been justly famous for comfort and regularity, determined to build a first-class liner which should greatly exceed in size anything that had yet been constructed, and the result was the "Oceanic," the first vessel to exceed in length the "Great Eastern." The "Oceanic" was 705 feet long, 68 feet beam, and normally she displaced 28,000 tons. Her best speed was 20.7 knots.

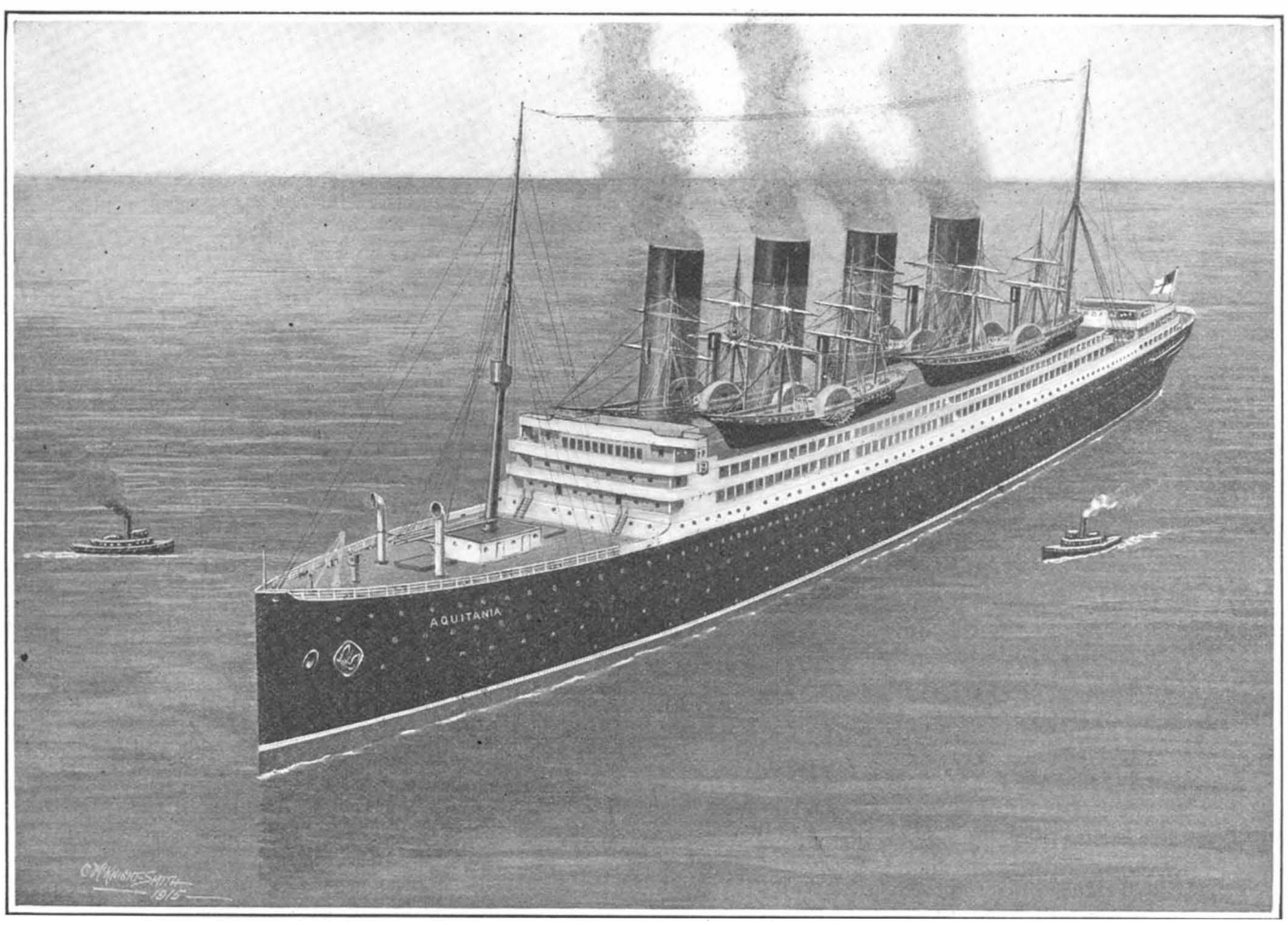
The Hamburg-American Line signalized its entrance into the contest for the blue ribbon of the seas by setting afloat in 1900 the "Deutschland," 686 feet long, and of 23,500 tons displacement. This vessel was equipped with twin screw, six-cylinder, quadruple-expansion engines, which on a voyage in which the "Deutschland" averaged 23.5 knots, gave a maximum indication of 37,500 horse-power. The North German Lloyd Company replied by building the "Kaiser Wilhelm II," a much larger vessel, 707 feet long and of 27,000 tons displacement, which with a maximum indication of 40,000 horse-power, also crossed the Atlantic at an average speed of 23.3 knots.

The very fine ships of the German company reached the high water mark of the development of the reciprocating marine engine, although in point of output the reciprocating engines of the "Olympic" in later years have equalled those of the "Deutschland" and "Kaiser Wilhelm II."

With the appearance in 1897 of the "Kaiser Wilhelm der Grosse," the blue ribbon of the Atlantic was captured by a German company, and it remained in their possession for a decade. In 1906, however, the Cunard Company, with the assistance of the British government, who loaned $13,000,000 at 2½ per cent interest for the purpose, set afloat the first high-speed transatlantic liners to be propelled by the steam turbine. These ships were the "Lusitania" and "Mauretania," 790 feet in length, 44,500 tons deep-draft displacement, whose turbines of 70,000 horse-power, operating four propellers, have driven both of these ships across the Atlantic at an average speed of slightly over 26 knots per hour. That speed has not since been approached, nor is it likely to be exceeded for many years to come. The shipowners claim that, were it not for the government assistance and the subsidy of $750,000 per year for carrying the mails, these ships, because of their enormous coal expenditure, could not be made a paying investment. This seems to be proved by the fact that all large and fast transatlantic liners built since the advent of the fast Cunarders, are of more moderate speed and, if we take into consideration their great size, of more reasonable coal consumption.

The next great advance in dimensions took place when the White Star Company built the "Olympic" and "Titanic." These vessels are 883 feet long, 92 feet 6 inches beam, and displace about 52,000 tons. The engine-room equipment is interesting, because of the fact that the steam is utilized first in two quadruple-expansion reciprocating engines of 38,000 horse-power, placed in the wings of the vessels, and from them exhausts to a large low-pressure turbine, driving a center shaft, which develops a shaft horse-power of 23,000. The great size of the "Olympic" made it possible to provide even more spacious accommodations than on the "Lusitania," and it was claimed for the "Lusitania" that the cubic space devoted to each passenger in the first-class accommodations was 50 per cent greater than that on any previous ship.

To the Hamburg-American Line belongs the credit for building the first ship over 900 feet in length. The "Imperator," which made her maiden trip in 1913, is 909 feet in length, with a beam of 98 feet and a displacement of 54,000




**The Cunard liner "Aquitania" of 1914 could carry the whole Cunard fleet of 1840 on her boat deck.**

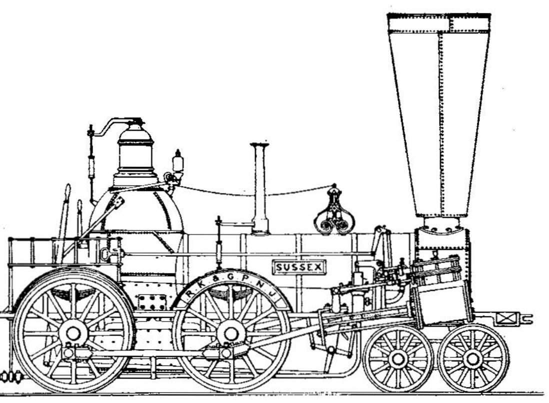



Fig. 1.—Engine with variable cut-off motion. 1845.

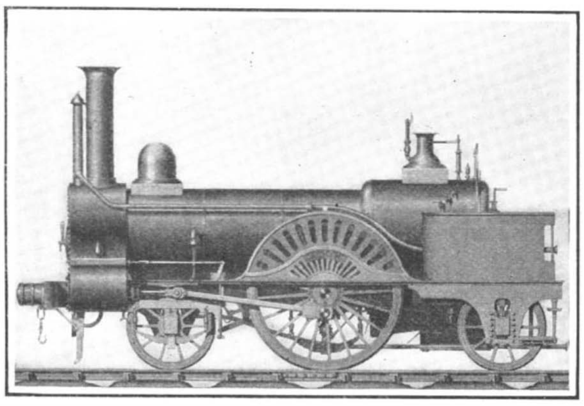


Fig. 3.—Beattie's smoke consuming engine with feed water heater. 1856.

tons. Her quadruple turbine equipment, with 60,000 shaft horse-power, has driven her at a speed of 22.5 knots. The following year the same company dispatched to New York a sister ship of larger size and greater speed, the "Vaterland." This enormous vessel is 950 feet long, 100 feet in beam, displaces 56,000 tons, and her turbines, of 75,000 horse-power, give her a transatlantic speed of 23.5 knots. The same year the Cunard Company put in service the "Aquitania," 901 feet in length, with a beam of 97 feet, displacing a little over 50,000 tons. Her model is finer than that of the "Imperator," and with 60,000 horse-power developed by her turbines she has made a speed of 23.5 knots.

The growth in size and comfort of the transatlantic steamship has been accompanied by an equally steady improvement in the motive power. The decade 1845 to 1855 witnessed the substitution of iron for wood, and during that period the approximate boiler pressure rose from 10 to 20 pounds per square inch; the approximate consumption of coal per horse-power per hour dropped from 4.5 to 3.5 pounds. From 1855 to 1865 the screw propeller took the place of the paddle wheel, the boiler pressure rose from 20 to 35 pounds, and the fuel consumption was reduced from 3.5 to 3 pounds. In the following decade, 1865 to 1875, the compound took the place of the simple engine and boiler pressure rose from 35 to 60 pounds, the coal consumption dropping from 3 pounds to about 2.5 pounds per horse-power per hour. In the decade 1875 to 1885, steel took the place of iron and the triple-expansion engine was introduced; the boiler pressure rose from 60 pounds to 125 pounds and the fuel consumption dropped from 2.5 pounds to 2 pounds. In the next decade, 1885 to 1895, twin-screw propulsion was introduced, as was also quadruple-expansion and the use of forced draft. Steam pressures rose from 125 to 200 pounds per square inch, and the coal consumption dropped from 2 to 1.5 pounds. In the decade 1895 to 1905 there was introduced experimentally the steam turbine. The work done by this type of engine in smaller vessels for cross-channel service and in one or two large ocean steamers paved the way for the introduction of the turbine during the next decade in the largest ships. A coal consumption of 1.3 pounds was reached by the large quadruple, six-cylinder engines which were the prevailing type in the fast transatlantic steamships, and the steam pressure was carried up to as high as 225 pounds. The decade of 1905 to 1915 witnessed the passing of the reciprocating engine and the substitution of the steam turbine. Although at first high boiler pressures were maintained, latterly it was found that lower pressures gave better results, and from 160 to 175 pounds is used on some important turbine-driven ships. The coal consumption dropped somewhat, but not as much as had been predicted, the best results showing a consumption of about 1.2 pounds per horse-power per hour.

**The Development of the Steam Railroad.**

Somebody has recently defined the present war in Europe as an engineers' war. It certainly is; and this for the reason that the age we live in is essentially, first and last, an engineers' age. Eliminate the work of the civil and mechanical engineer from the past seventy years, thoughtful reader, and you will realize at once that you have eliminated 90 per cent of those comforts, conveniences and broad practical achievements that make the present the wonderful age which it is.

If we were asked to name the one field of his activity in which more than any other the engineer has rendered possible the present material advancement of mankind, we should be tempted to name that of transportation. There is a broad sense in which we may say that the struggle of man up to an ever higher civilization is a fight against physical inertia—the inherent tendency of things to remain what they are and stay where they are.

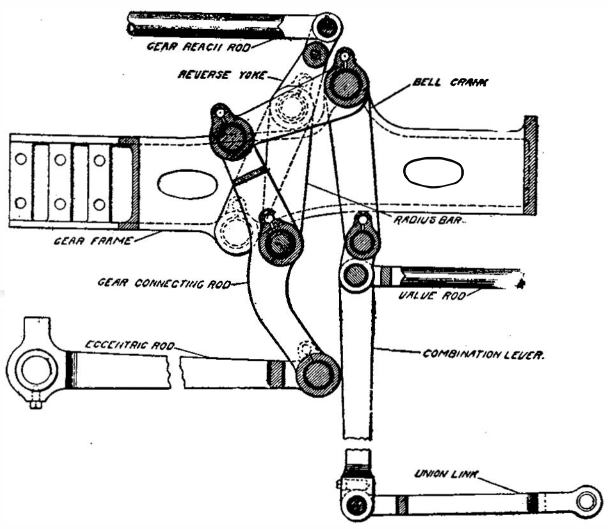



Fig. 5.—The Baker valve motion.

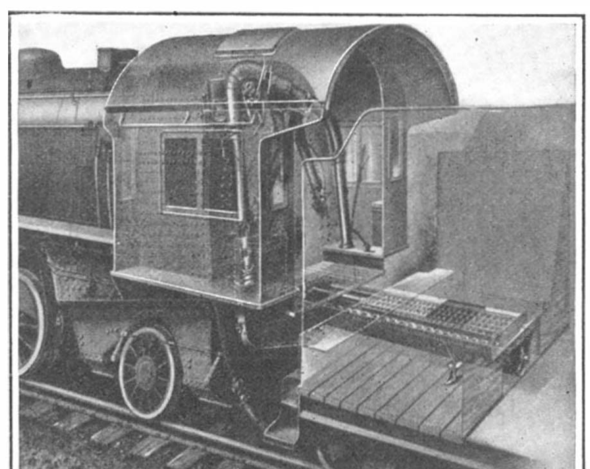


Fig. 6.—Street's mechanical stoker. 1915.

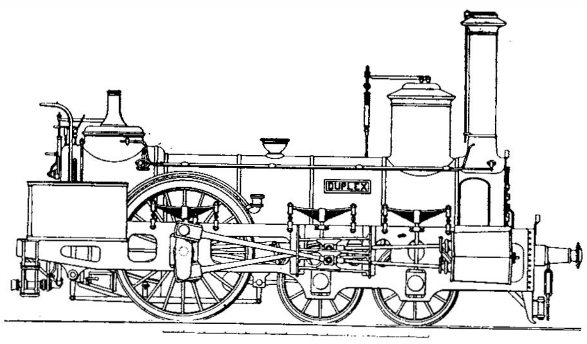



Fig. 2.—Haswell's four-cylinder engine. 1861.

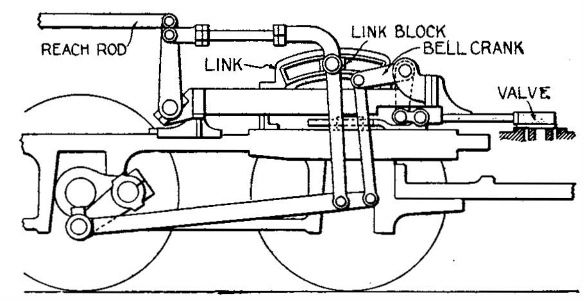



Fig. 4.—The Southern valve gear.

Transportation, then, as represented by the railroad and the steamship, lies at the very foundation of those marvelous developments of manufacture and commerce, with their resultant comforts and conveniences, which, during the seventy years covered by the life of the Scientific American, have been so great as to more than equal all previous advancement in the practical arts throughout the history of mankind. Thus, in the case of the great steel industry: Nature had provided vast stores of coal in one part of the North American continent, equally abundant stores of iron ore in another district, and elsewhere the necessary limestone. But without the transportation facilities afforded by the steamers of the Great Lakes and the steam railroad, we would possess to-day no great center of the steel industry, such as exists at Pittsburgh, nor any means of distributing the various products of its steel mills swiftly and economically throughout the whole world. Again, had the railroad and the steamship never been developed, it is safe to say that the greater portion of the wheat lands of the country would be still wild prairie, its forests would be uncut, its wealth of minerals scarcely touched, and the inertia of nature would still weigh heavily upon the land. The American railroad is as distinctively American as is our agricultural machinery. The early development of European railroads took place under exceptionally favorable conditions, for the population was dense and capital for construction work was plentiful. In Europe the population preceded the railroad, but in America it followed the railroad; in fact, it would be not stretching the point too far to say that throughout the greater part of the United States the railroad has been the pioneer of civilization.

Because of these conditions, it was possible to build the early European railroads upon a scale of solidity and excellence, which was impossible in the United

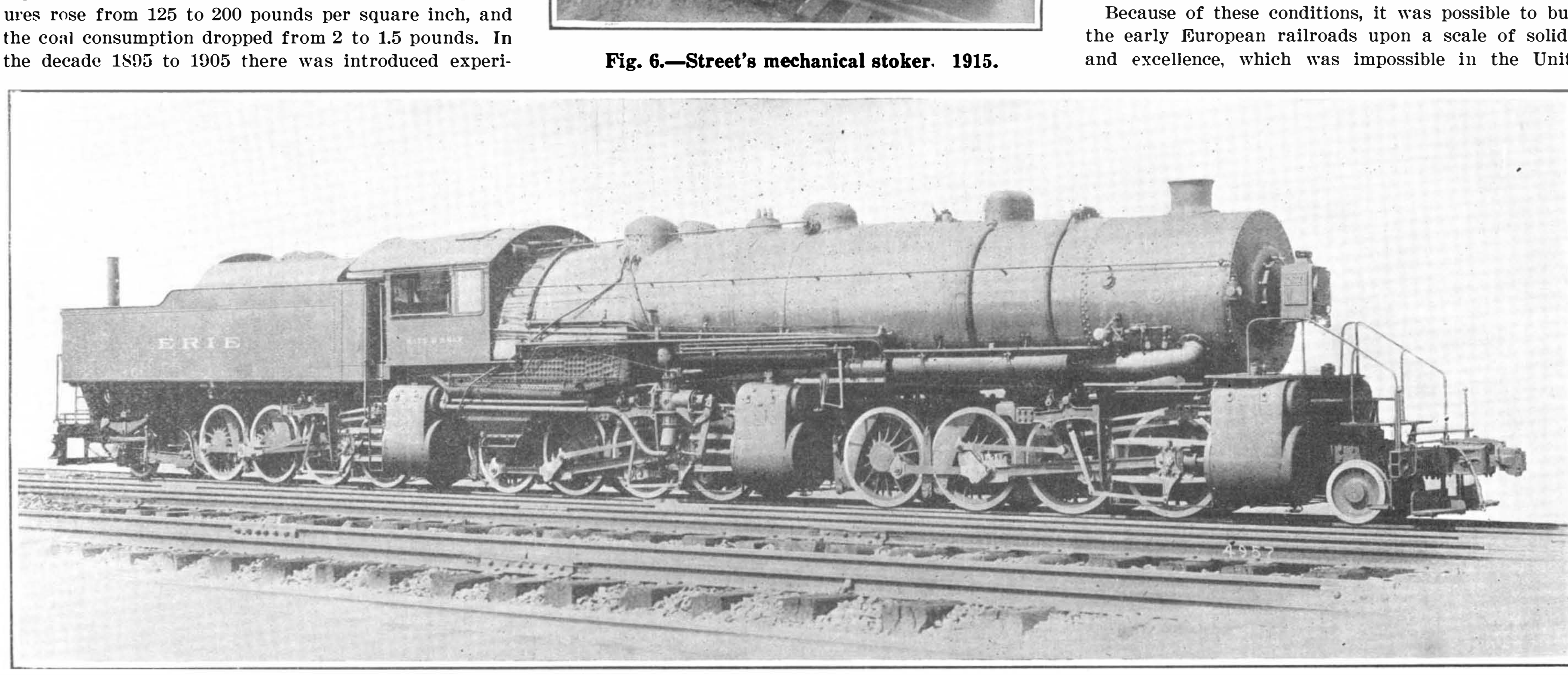



Fig. 7.—The Erie "pusher," largest locomotive in the world.

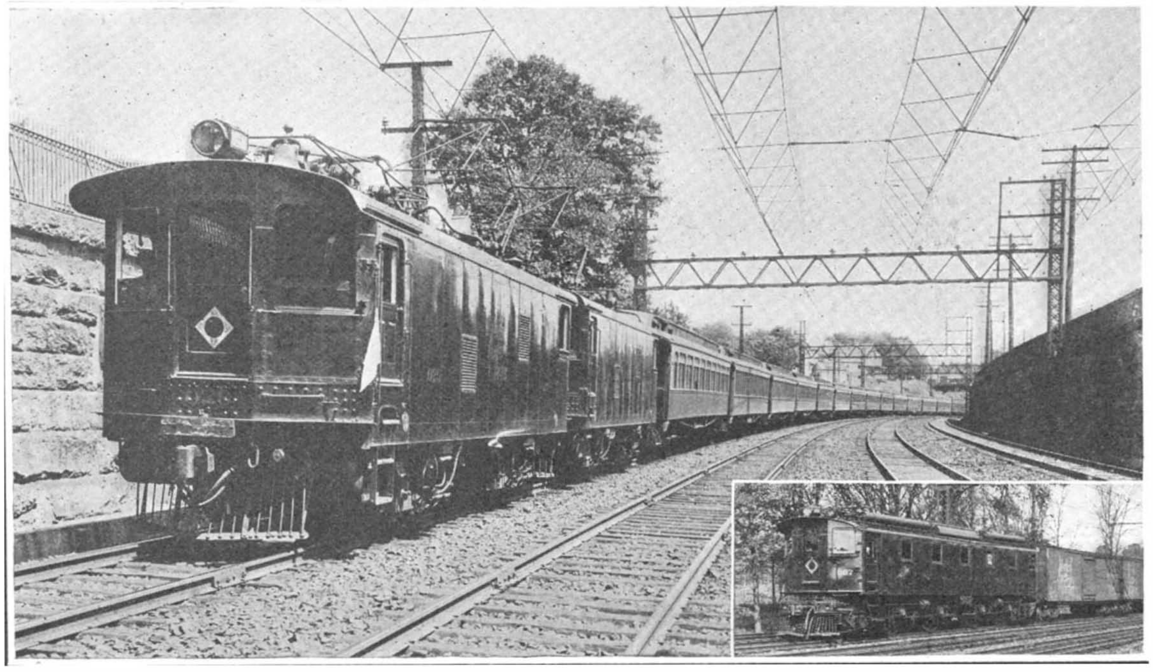
States at the same date. One of the most creditable features of our early railroads was the ingenuity shown by our engineers in building the roads to suit at once the topography of the country and the limited capital which was available for construction. In laying out the lines the locating engineer endeavored to reduce the amount of cutting and embankment to a minimum; and hence he did not hesitate, at the expense of greater distance and sharp curvature, to run his line around a hill in preference to tunneling through it. Steel suitable for bridgework was scarce and costly; but the forests of America provided unlimited stores of fine structural timber. In place of building a costly steel viaduct or solid embankment across a ravine or narrow and steep-sided valley, the American engineer erected timber trestles, and did not hesitate to span broad rivers with trussed bridges of timber of a length which had never been approached in the history of wooden bridges.

The railroad and track of 1845 were of simple and cheap construction. The rails weighed from 40 to 50 pounds per yard, the ties were small, and more often than not they were laid directly upon the graded ground without the interposition of gravel or broken stone ballast. But as the population increased and manufacture and commerce multiplied and dividends became more plentiful, there was a contemporaneous improvement in the roadbeds and the rolling stock. With the Bessemer process there came the steel rail—harder, stiffer, and more durable. Steel also took the place of timber in bridge construction; and as funds became available the engineers were sent out over the line to re-locate them, reducing the heavy grades, easing up the curvature, eliminating trestle work in favor of solid embankments, thus bringing the roadbed and track up to the level of modern practice. Some of our great systems, such as the Pennsylvania and the Union Pacific, in the last decade and a half have spent from forty to sixty millions of dollars in the mere improvement of the roadbeds, this big outlay being based upon the now-well-understood fact that the easier the curvature and the lighter the grade, the larger is the paying train load that can be hauled per locomotive and per a given size of train crew.

In pursuance of this policy, as soon as it was demonstrated that the saving in fuel and maintenance and the economies in the wages of train crews would exceed the fixed charges on the outlay necessary for the improvement of the roadbed and track, the work of reconstruction has been put in hand. Consequently, where the traffic is sufficiently heavy to guarantee the change, our railroads have been brought fully up to that of the best European practice.

It may come as a surprise to some of the readers of the Scientific American to learn that practically the whole of our vast railroad system, now totaling 253,000 miles, has been built during the life of this journal. Thus, in the year 1845 there was in the whole United States only 4,633 miles of road, which was made up of a small number of disconnected lines to be found in the Atlantic and Southern States, and a few fragmentary systems located in the Middle States. That year the eastern railroads were commencing to creep across the Alleghenies into the Mississippi Valley; but as yet there was no indication pointing to the development of a through trunk line.

Tracing the development of the railroad by decades, we find that from 1845 to 1855 the total length of all railroads grew from 4,633 miles to 18,374 miles. By 1865 the total had reached 35,085 miles, and ten years later it was 74,096 miles. In 1885 it had risen to 128,-320 miles and the lapse of another decade brought it up to 180,657 miles. At the opening of the twentieth century the 200,000-mile mark had been passed, and in 1905 the total length of all railroads was 218,101 miles. In 1913 the most reliable statistics credit the country with a total of 249,802 miles, and the latest figures available, those for 1914, show that our railroad system has reached the stupendous total of 253,000 miles.



Electric passenger and freight trains on the New York, New Haven & Hartford Railroad.

A notable event, and surely the most epoch-making, was the completion on May 10th, 1869, of the first trans-continental road across America, the Union Pacific.

The distinctive American passenger car, with its long body carried upon end swiveling trucks, was patented by Ross Wynans in 1834, and by the year 1845 it was well established as the typical American car. The passenger car in those days was from 9 to 10 feet wide, 45 to 50 feet long, and it carried about sixty passengers. It was lighted by oil lamps and warmed in winter by a wood-burning stove, both of these being frequent causes of fatal fires when the all-too-frequent collisions occurred. The improvements in car construction of the past seventy years have been in the direction of comfort, strength and safety. First, there came the abolition of the oil lamp and the introduction of Pintsch gas; the dangerous wood or coal stove was abolished and the trains were heated by steam taken from the engine. Finally, during the past two decades, there has been a gradual substitution of steel for wood as the material of construction, a change which has contributed greatly to the lowering of the death rate in collisions and other train accidents.

The great distances between important cities and the ever-increasing length of railway journeys led to the introduction of the sleeping car, and in 1864 Pullman brought out his first sleeper, which was known as the "Pioneer." Shortly thereafter the Pullman Company was organized and, mainly due to its efforts, the sleeping car has been brought up to its present standard of strength and comfort.

Of all the improvements in railroads designed to expedite travel and promote the safety of both passengers and freight, by far the most important are the automatic air brake and the block signal system. Limitations of space do not admit of more than a passing reference to these. The continuous automatic airbrake, named after its designer, George Westinghouse, Jr., was first put into practical service on a trunk line railroad in 1868 to 1869. By means of this system of control, the engineer in his cab, by means of a lever, can instantly set the brakes in every car throughout the train and on his own engine; moreover, should the train break apart, the brakes will automatically set themselves. The simplicity of operation, the enormous power of this brake, and the certainty with which it operates render it one of the most successful inventions of any age. In the Burlington brake trials held in 1886 to 1887, a train of fifty freight cars, running at 40 miles an hour, was stopped in a distance measuring a third of its own length. The improvements in the airbrake during the past twenty-five years are shown by the following comparisons:

A train in 1890, weighing 280 tons and going 60 miles an hour, even if it were equipped with the best airbrake of that day, could not be stopped in less than 1,000 feet. A train in 1915, weighing 920 tons and going 60 miles an hour, has an energy in foot-tons nearly four times as great as that which had to be dissipated in stopping the train of 1890. With the 1890 brakes the 1915 train could have been stopped in perhaps 1,760 feet, but that same 1915 train, with the improved electro-pneumatic Westinghouse airbrake, can be stopped in 860 feet.

The block signal system, the greatest of all preventers of railroad collision, has seen a gradual evolution from the time when the crude idea was first entertained and acted upon. In 1845 there was practically no block signaling in this country, even in an embryonic form. The development of block signaling is to be credited to Europe, and mainly to Great Britain, in which country, as far back as the year 1890, 98.5 per cent of the English railroad lines were equipped with block signals. Under this system, in the operation of trains, no two trains are allowed upon the same "block" or section of line at the same time; in other words, the trains are kept apart by space instead of by time.

The Pennsylvania was the first to make extensive use of the system, which it did in 1864. In 1886 the Canadian Pacific advertised that it made use of the block signal system. America's contribution was the introduction of automatic signals, in which the train, through an electric circuit through the rail, operates its own signals and safeguards itself automatically. Automatic signals were first used in America in 1871 on the Eastern Railroad in Massachusetts, and the first automatic signals using the now universal track circuit, were used in Massachusetts in 1879.

Some will consider that the automatic stop, the latest improvement in connection with block signaling, is the most important safety device of all. It consists in tying the signals in with the moving train, in such a way that if an engineer runs by a signal, the signal itself will automatically set the brakes and stop the train. The most brilliant success has attended the installation of the automatic stop on the New York subway. Here the express trains are run at 40 miles an hour under a headway of less than a minute and three quarters.

(Concluded on page 556.)


The first electric train of the New York Central leaving the Grand Central station, New York city, on September 30th, 1906.

# Seventy Years of Civil Engineering

## Retrospective Review of the More Important Works Completed During the Life of the Scientific American

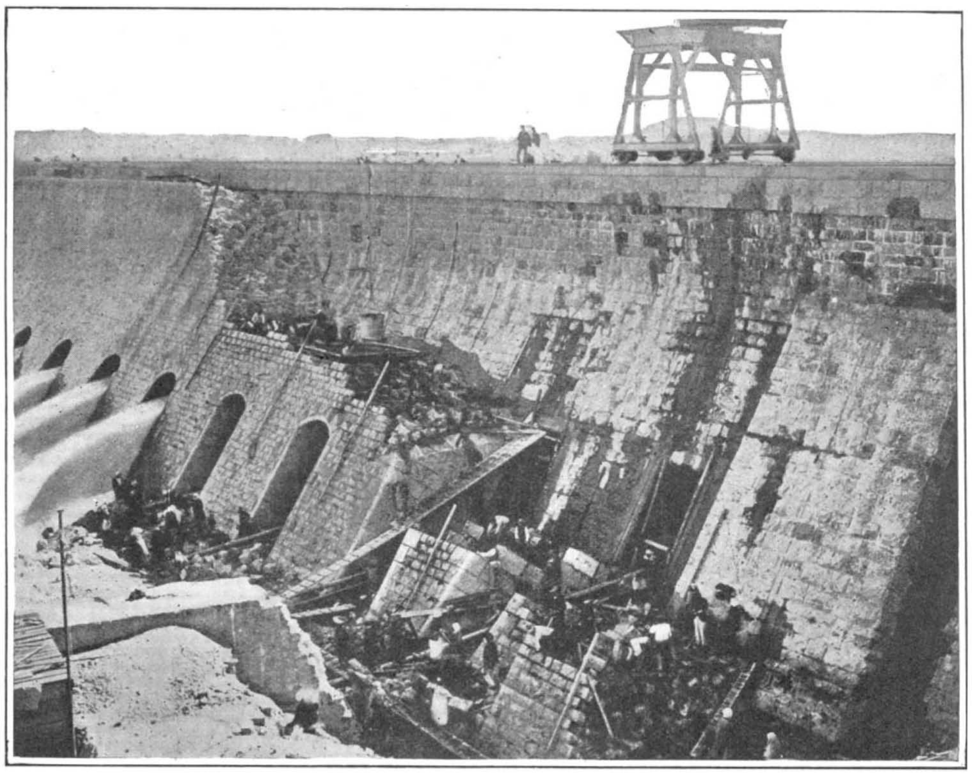
THE story has been told of a monarch who once asked a civil engineer what was the limit of the constructive ability of his profession, and he answered, "Give me sufficient money, men, and time and I will accomplish anything." There is just enough of truth in this to cause us, when we contemplate the engineering works of the present day, to hesitate before we say: This is final. The Panama Canal, the Forth Bridge, the Aswan Dam, the Catskill Aqueduct, and all such works of magnitude are after all but the pledge and promise of greater things to come. The civil engineer, by continually providing improved methods of transportation, and making available nature's stores of crude material, enables the great mechanical industries to provide him with larger and better tools with which he is increasingly able to exceed the great performances of the past.

It is impossible within the limits of this article to give much more than an encyclopedic review of the vast field of civil engineering during the past seventy years—we can do no more than touch upon the high points in the vast field that is opened up to retrospective analysis.

**Water Supply and Irrigation.**

The art of impounding water and distributing it by canal and aqueduct for the use of farm and city is as old as history itself; and, at the period of the birth of the SCIENTIFIC AMERICAN there were scattered throughout the world many modern and important reservoirs which differed, not in principle, but merely in magnitude, from the great works of the present day. A typical system was that known as the old Croton Dam with its aqueduct leading from the valley of the Croton River to New York, which was opened about the time that this journal came into existence. After some fifty years of service it was realized that the supply of water from the Croton reservoir would soon be insufficient for the needs of New York, and the great structure known as the new Croton dam was commenced in the early nineties. This handsome structure stands today as one of the greatest masonry dams in existence. It is built of solid masonry and its foundations which lie, at the lowest point, some 140 feet below the bed of the river, extend up and down stream 200 feet, while above the mass of masonry rises to a height of about 300 feet. The total length, including the spillway, is 2,168 feet, and the total amount of water impounded is seventy billion gallons. The new and old aqueducts leading from the reservoir, together with other local sources of supply, made it possible to deliver nearly four hundred million gallons of water per day to New York city.

The Croton reservoir had not been long in operation before the rate of increase of population of Greater New York was so rapid as to render urgently necessary the preparation of plans for a fresh supply. It was determined to bring in the mountain water from the Catskills, and to this end a solid masonry dam known as the Olive bridge dam was built across the valley of the Esopus, forming the Ashokan reservoir, whose capacity is 132 billion gallons. The dam is 192 feet thick at the base and 220 feet high. The water is conveyed to New York city by an aqueduct from 14 to 17 feet in diameter, which extends for a distance of ninety miles. At the northern limits of New York the aqueduct



**Increasing the thickness and height of the Aswan dam, Egypt. Capacity, 82,000,000,000 cubic feet.**

drops to a deep tunnel, which is carried everywhere in rock throughout the full length of Manhattan, at depths varying from 300 to 750 feet. At intervals shafts rise to the surface, and from these the water is distributed by steel pipe mains. A branch tunnel passes under the East River to Brooklyn, where the aqueduct is continued to the Narrows, under which it is carried by pipes laid in the bed of the channel for the service of Staten Island. The work, which is approaching completion, will cost $170,000,000, and it will provide New York with an additional daily supply of 500,000,000 gallons.

Another great water supply scheme in the United States is that for the service of Los Angeles. The water is conveyed from the Sierra Mountains by means of an aqueduct which is partly open canal, partly covered canal, partly in tunnel, and, where it crosses the valleys, consists of large siphons 7½ to 11 feet in diameter. The total length of the structure is 254 miles, and in its completed condition it will supply Los Angeles with 250,000,000 gallons of water daily.

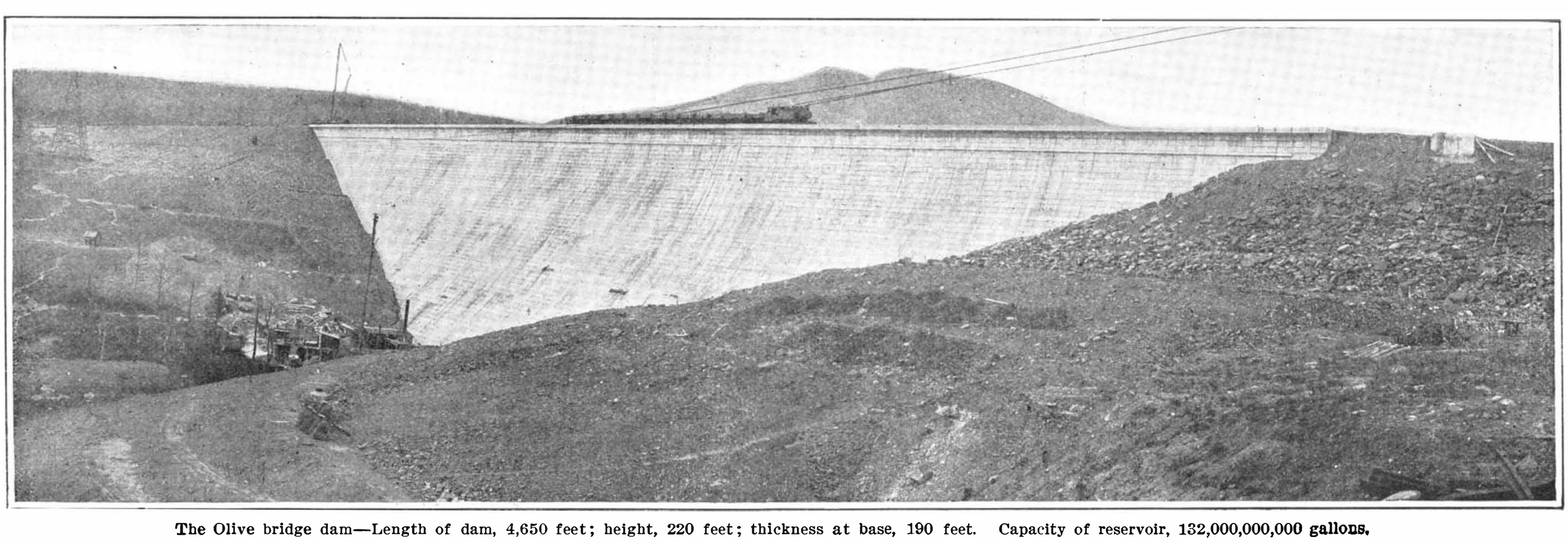
The greatest irrigation project in the world is that being carried out by the United States Government for the reclamation of desert lands lying between the Mississippi and the Pacific Coast. The great work consists mainly in the construction of dams, most of them of great size, for impounding the flood waters of the rivers and streams of the west and providing a vast system of irrigating canals for its distribution during the dry season. In some cases the dams are of limited height, but great length; in others they are short and of great height, as in the case of the Roosevelt and the Shoshone dams, which are over 300 feet in height, and the Boise Canyon dam, 350 feet high. These are the loftiest structures of the kind in the world. The canal system includes 341 miles carrying over 800 cubic feet per second, 375 miles carrying 300 to 800 cubic feet, and of 6,000 miles of smaller canals. When the project is fully completed over 3,000,000 acres of land, hitherto barren and desert, will be brought under cultivation.

In this connection, our thoughts turn naturally to that other great irrigation scheme rendered possible by the huge Aswan dam in Egypt. This world-renowned structure is built of solid masonry and extends for over a mile across the bed of the Nile. As recently enlarged by the addition of sixteen feet to its height and a proportionate increase of thickness, it provides a maximum head of water of eighty-six feet, and impounds the enormous quantity of 81,-200,000,000 cubic feet of water. The dam is pierced by sluice-gates, by which the stored water is released for the use of the Egyptian agriculturalist as it is needed.

The great dam constructions for water supply are matched by those built for the development of hydro-electric energy—a field in which, because of limitations of space, we must be content to mention only the last and largest plant of all—the Keokuk dam across the Mississippi. This is a private commercial venture, built to furnish light and power in the Mississippi valley. The dam, 4,278 feet in length, reaches clear across the Mississippi; it is founded on good rock and has a bottom width of 42 feet and a height of 53 feet. The floods are controlled by gates, built in the dam. The power is developed in a vast power house, 132 feet wide and 1,718 feet long, which contains 30 hydro-electric units, each of 7,500 kilowatt capacity.

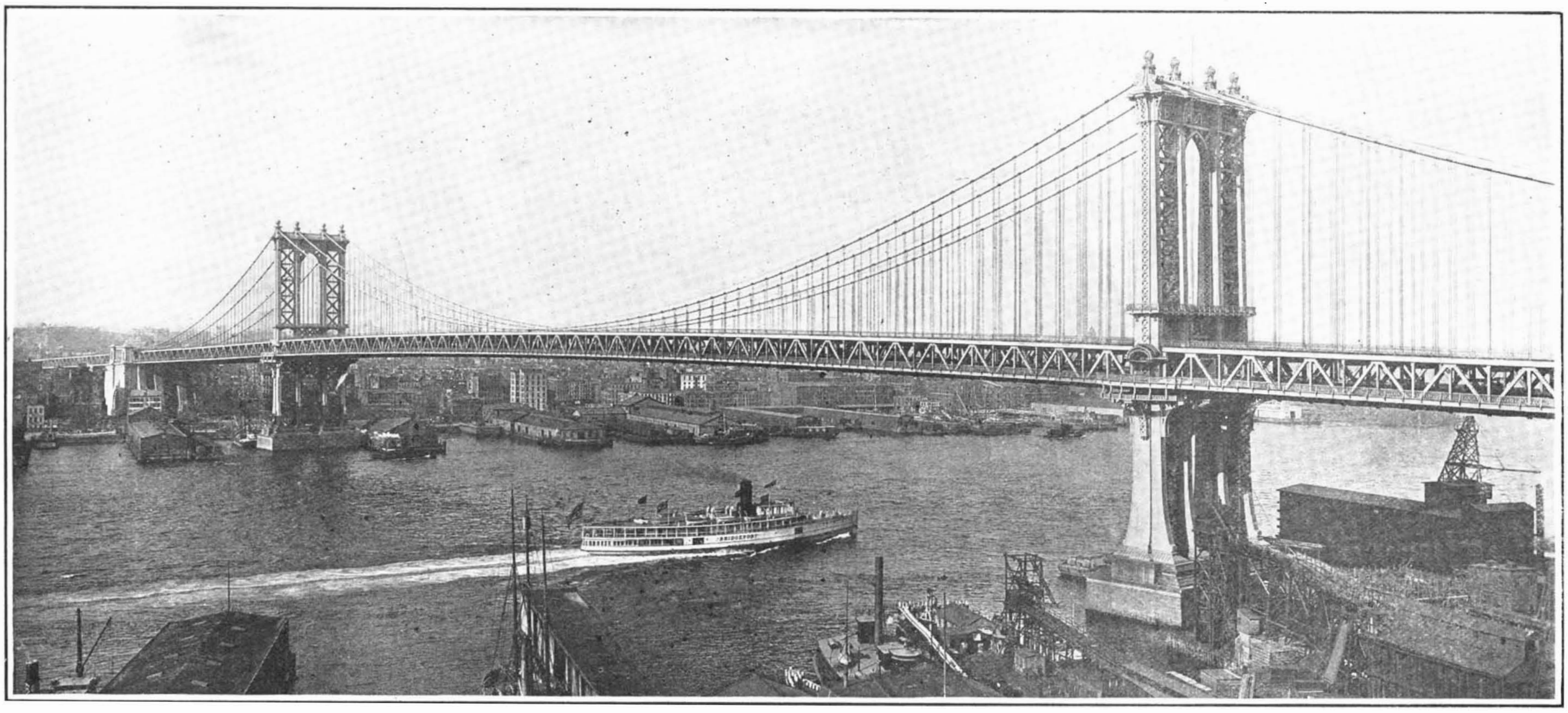
**Long-span Bridges.**

In tracing the development of bridge design and construction in this country and abroad, we find that, early in the period under review, American practice showed a broad divergence from that common in Europe. In the United States the typical American bridge, particularly the truss bridges used for railroad work, was designed with trusses of great depth and with long members of rather small cross sections, the result being to give to the American bridge an appearance of lightness and fragility, which, at least as far as its strength was concerned, was misleading. Probably a predisposing cause to this, and particularly to the universal adoption of the eye-bar for tension members, was to be found in the necessity for strict economy and in the universal desire of the American manufacturer to standardize work in the shop and in the field, and produce a type of bridge which would be easy of construction and erec-



The Olive bridge dam—Length of dam, 4,650 feet; height, 220 feet; thickness at base, 190 feet. Capacity of reservoir, 132,000,000,000 gallons.

**A monumental work in the Catskills for supplying New York daily with 500,000,000 gallons of water.**



Copyright by Irving Underhill

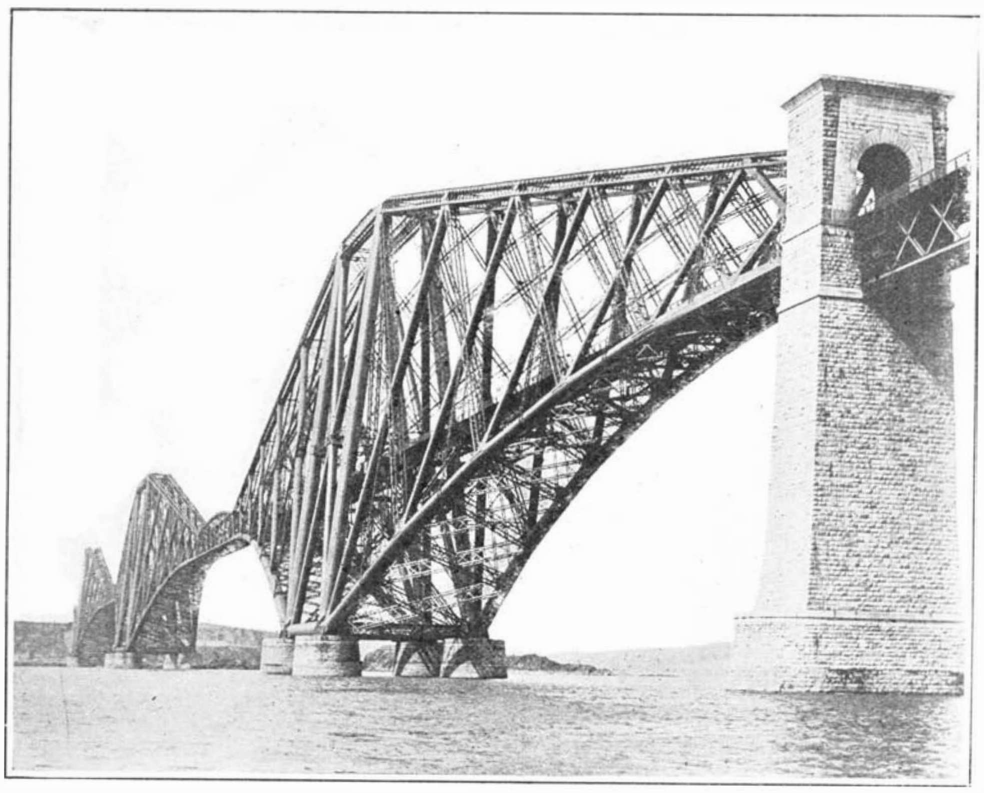
Main span, 1,470 feet. Shore spans, 725 feet. Width of floor, 120 feet. Capacity: Four electric railways; a 35-foot roadway, and two 10-foot footpaths.

**The Manhattan suspension bridge across the East River, New York.**

tion, and relatively to other types of bridges would be economical in cost. In Europe the bridge engineers favored riveted construction and a shallow depth of truss, and this involved an increase in the section of the various members and also a general increase in the weight of the bridge. The American eye-bar bridge had the advantage of cheap cost and quick construction and erection, while the European bridge, requiring more time, at least for erection, and costing more, had the advantage of greater stiffness and general rigidity.

During the past fifteen or twenty years, the two schools of design have drawn together or overlapped; so that now the eye-bar is not unknown in later European designs, and the riveted bridge is becoming increasingly popular in America.

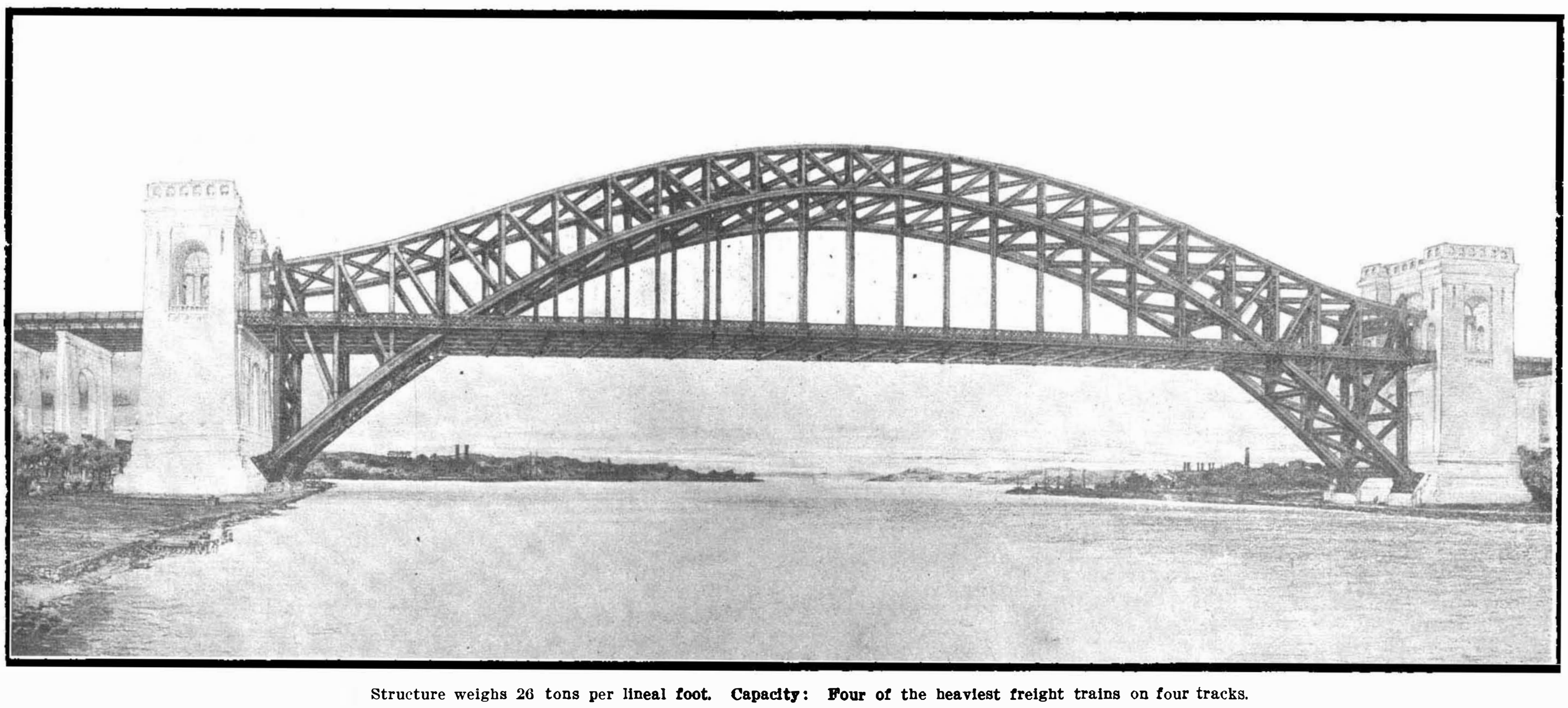
Seventy years ago that justly celebrated engineer, Robert Stephenson, presented plans for an entirely new type of bridge, each span of which consisted of a rectangular, plate-iron tube, the structure being designed to carry the tracks of the London and Northwestern Railway across the Menai Straits. The bridge



The two main spans are each 1,710 feet long. Carries two railroad tracks.

**Forth bridge, Scotland; largest cantilever bridge in existence.**

was built double—that is to say there was a track within each tube, the spans consisting of four of 230 feet and four of 472 feet. This bridge produced as much astonishment and doubt as to its feasibility as the Brooklyn bridge or the Forth bridge did in later days; but it proved a great success and is in active service to-day. Of the same type was the Victoria bridge across the St. Lawrence River, a monumental structure, consisting of 25 spans, each 244 feet in length. It was removed about fifteen years ago to make way for a more modern structure. In 1855 Roebling built the Niagara suspension bridge with the then unprecedented span of 821 feet, and nineteen years later he commenced the construction across the East River, New York, of that truly beautiful and monumental bridge with which his name will be ever associated. The Brooklyn Bridge, as it is now called, is carried upon four 15-inch wire cables. It consists of two shore spans, each 900 feet in length and a main river span 1,595 feet between the towers. The work was completed and opened in 1883. In point of size and capacity there was



Structure weighs 26 tons per lineal foot. Capacity: Four of the heaviest freight trains on four tracks.

**Hell-Gate bridge over the East River. Longest arch bridge yet built.**

nothing to approach this structure at that time in all the world. The suspension bridge is a peculiarly American type, especially for long-span work. In 1895 the Williamsburg bridge over the East River was commenced, and after about seven years' work was opened. This structure was far more solid and had much greater capacity than the Brooklyn bridge, the full width of the floor system being 118 feet, as against the 80 feet of width of the earlier structure. This was followed by the Manhattan bridge with a main span of 1,470 feet, and a full width of 120 feet.

The great rival to the suspension bridge for long-span work has always been the cantilever, and of this type the most notable example is the great structure across the Firth of Forth, a few miles above Edinburgh, Scotland. This is a two-track railway bridge, and at the time it was built it was the wonder of the engineering world, and it is to-day and must forever be one of its most monumental structures. The two main spans measure 1,710 feet in the clear and its most interesting structural feature is the fact that the compression members are big tubes, generally of circular section, measuring from eight to twelve feet in diameter. The tension members are of lattice work. Benjamin Baker, its principal designer, said that he started out to build the stiffest and strongest large bridge in existence; and he succeeded in doing so; for the heavy express trains to and from North Scotland cross it at speeds of 60 miles an hour and over.

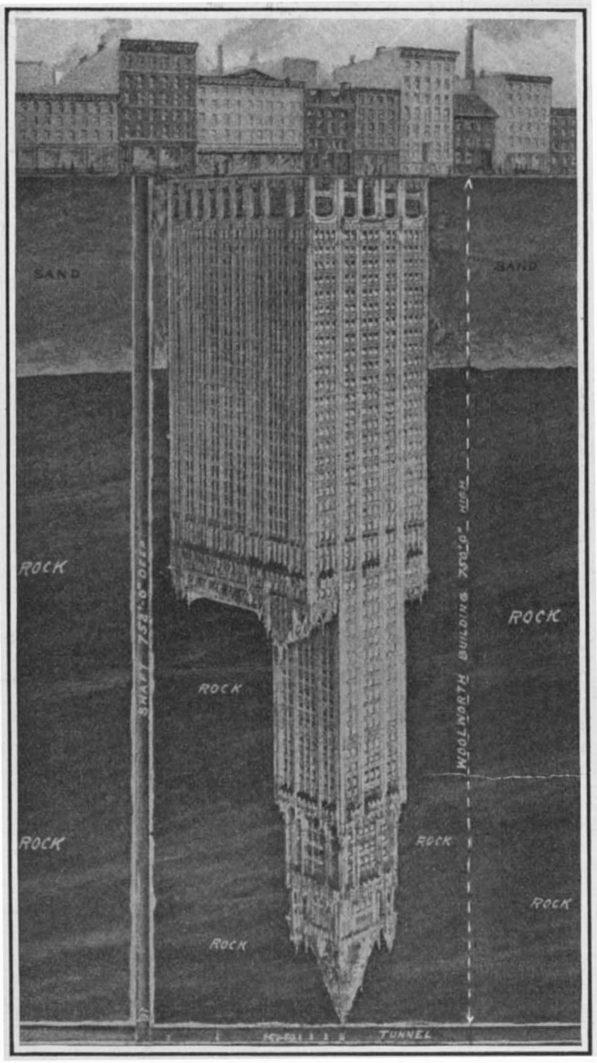
The new Quebec bridge across the St. Lawrence, which will replace the structure which collapsed a few years ago, consists of a main river span of 1,800 feet. This will be the longest cantilever span in existence. The bridge carries two railroad tracks, and it will weigh 18 tons per linear foot.

The longest single span arch bridge in the world is that which is now under construction across the East River at Hell Gate, which will provide four railroad tracks capable of carrying the heaviest freight trains in existence. It measures 1,017 feet between piers, and it rises 220 feet from the hinges to the crown of the chords. Its weight will be enormous, namely 26 tons per lineal foot of the bridge. The size of its members is shown by the dimensions of the lower chord, which is rectangular and about seven feet wide, and varies in depth from seven and one half feet at the crown to ten and a half feet at the abutments.

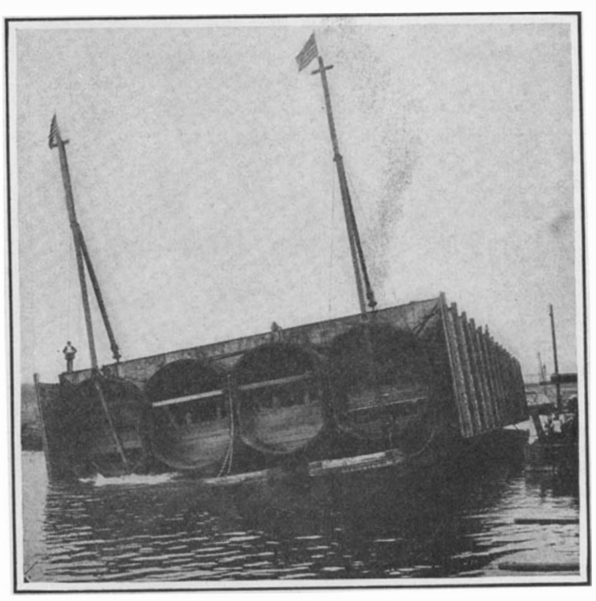
What the future will see in the way of the development of long-span bridges is suggested by the fact that plans are made and financial negotiations are under way for the construction across the North River of a double-deck combined freight-and-passenger suspension bridge, capable of carrying sixteen tracks, whose span between the main towers will be about 3,000 feet. The main towers of the bridge will rise over six hundred feet above the surface of the river.

**Canals.**

The construction of canals for inland water transportation dates from the earliest times. At the opening of the period under review, the Erie Canal connecting the Hudson River with Lake Erie may be taken as typical of such work both here and in Europe. It was opened in 1825, when it had a maximum depth of four feet, and its total length was 363 miles. Between 1836 and 1862 it was gradually improved, the depth being increased to seven feet; and at that time it had seventy-two locks. During the past decade further improvements have been undertaken with a view to increasing its capacity, and the work now under way and within measurable distance of completion will provide a canal with a minimum depth of twelve feet, capable of taking barges of 1,000 tons. The canal leaves Lake Erie at an elevation of 565.6 feet above tide level, and reaches tide level on the Hudson River at Waterford. In the new canal the number of locks is reduced to 50, and the whole work of improvement at completion will have cost about $125,000,000.




**New York's highest building and deepest shaft. Where the aqueduct dips under the East River it sinks to a depth of 750 feet below the surface.**



**Launching section of Harlem River subway tubes. Flat boats being sunk to set the tube section afloat.**

The period under review has seen the completion of several great canals of the largest capacity designed for the use of ocean shipping. The first of these was the Suez Canal, which connects the Mediterranean with the Red Sea. It was built by De Lesseps and completed in 1869. Originally it had a bottom width of 120 feet, 250 feet width at the surface and was 28 feet deep. In 1897 work was begun on the enlargement and deepening of the canal to a minimum depth of 31 feet. It has been improved, not only by increasing its width, but by the construction of several large and commodious sidings to facilitate the passing of vessels.

The Kiel Canal, stretching from the mouth of the Elbe to the Baltic, a distance of sixty miles, was begun in 1887 and completed in 1895, with a bottom width of seventy feet and a top width of 220 feet, and a depth of 29½ feet. This year the work of reconstruction and enlargement was completed, and to-day the canal has a top width of 335 feet, a bottom width of 144 feet and a minimum depth of 36 feet. The locks, 1,082.6 feet long by 147.6 feet wide, are the largest in existence. The canal is proving its vast military importance during the present war.

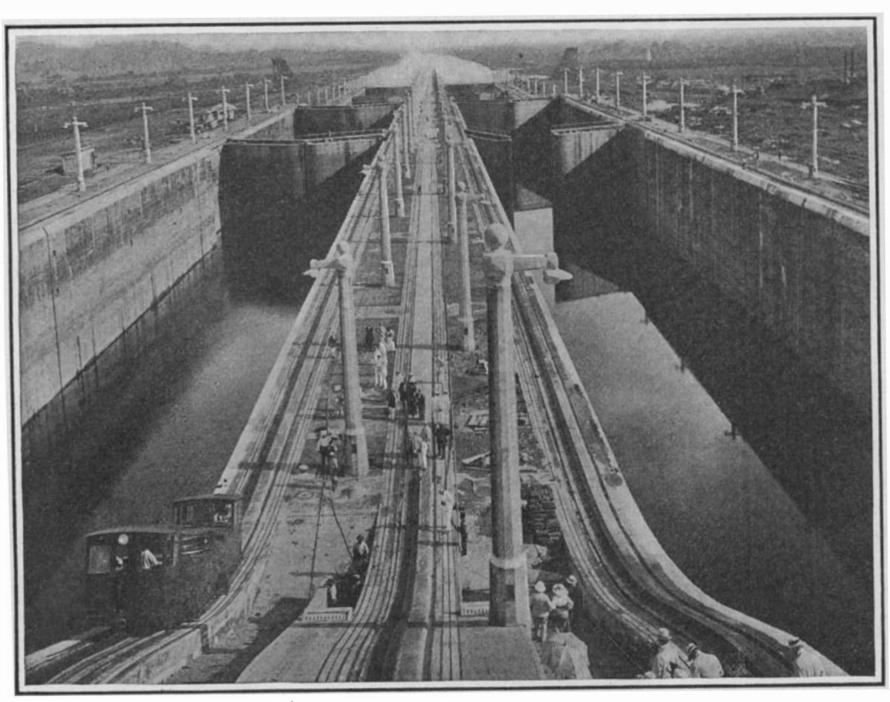
The greatest of all works of this kind, however, so great indeed, as to be in a class by itself, is the Panama Canal, which was commenced in the early eighties by De Lesseps, and after many years of fruitless endeavor, was finally purchased by the United States Government, and has recently been completed by the United States engineer corps. The Panama Canal is remarkable not so much for its length, which is fifty miles from deep water to deep water on the Pacific, as it is for its great width and depth, and for the enormous amount of excavation involved and the great difficulties encountered because of the climate and because of the unstable nature of the ground through which it is cut. Our American engineers solved the problem of the turbulent Chagres River by building the great dam at Gatun, with its surface level eighty-five feet above the sea and a surface area of 165 square miles. The lake extends from Gatun, some eight miles from the Atlantic, to the farther end of the Culebra cut, a total distance by the channel of 32 miles. The dam is over 2,000 feet wide at its widest point, and its crest is 115 feet above sea level. The depth of the canal throughout is 45 feet. Its minimum width at the bottom is 300 feet, and its maximum width 1,000 feet, where the channel passes through Gatun Lake.

The locks have a usable length of 1,000 feet and a width of 110 feet. The total amount of excavation long ago passed the 200,000,000 cubic yard mark, and it is continually increasing. The canal is finished except for the removal of the slides, which will probably continue to come down into the canal prism until the unstable material in the Culebra cut has reached its natural angle of repose. It is possible that the final total of excavation when this point is reached will be between 230,000,000 and 240,000,000 cubic yards. The total cost of the canal will be about $400,000,000.

**Sub-aqueous Tunnels and Subways.**

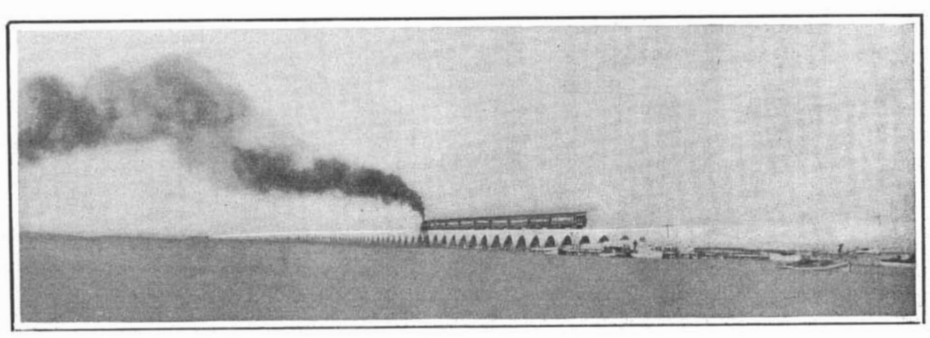
Over the portals of the main towers of one of the early suspension bridges, that over the Avon at Clifton,

(*Concluded on page 558.*)

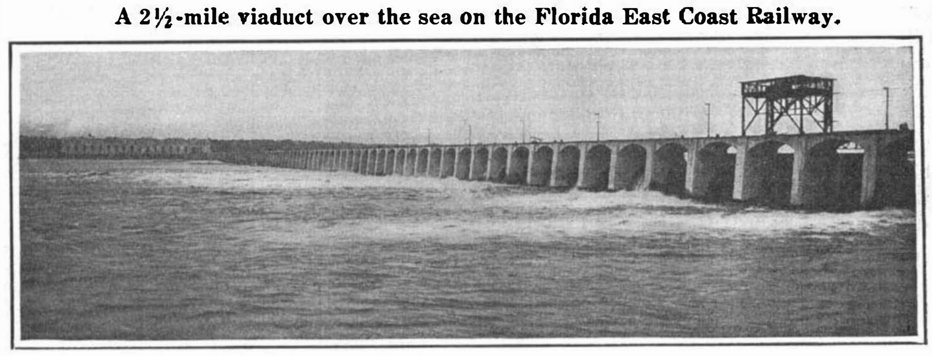


Copyright by Brown & Dawson

**The Gatun locks of the Panama Canal. Each basin is 110 feet wide by 1,000 feet long.**

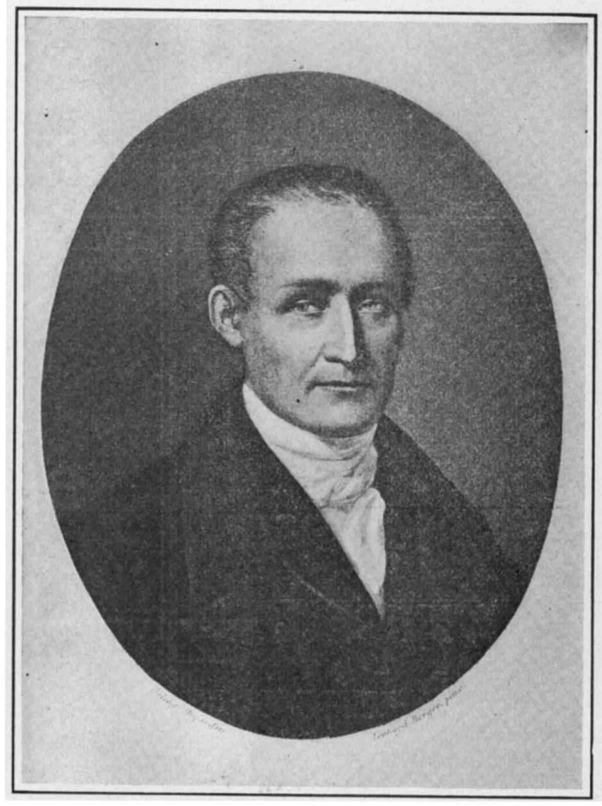


**A 2½-mile viaduct over the sea on the Florida East Coast Railway.**



**Keokuk dam across the Mississippi River for generating 300,000 horse-power. Height, 52 feet. Length, 4,850 feet.**


Louis Daguerre, from a daguerreotype.


Joseph Nicéphore Niepce, inventor of photography.


Fox Talbot, the father of modern photography.

# The Invention and Development of Photography

## From the Daguerreotype to the Moving Picture

THE father of photography was Joseph Nicéphore de Niepce, whose process appeared in 1824. In the Niepce process, a silver-faced copper plate was coated with asphalt dissolved in oil of lavender and dried. It was then exposed to light in the camera, or in the case of an engraving, by superposition. Thereupon it was washed over with a combination of one part of oil of lavender and ten parts of petroleum. The picture was then washed in water and dried. Next the plate was placed in an iodine fuming box until the bright silver ground turned dark. On removing the part of the asphalt remaining, the lights and shadows of the picture appeared in their proper relation, or instead, the plate was etched and inked and printed as in ordinary etching.

Next came L. J. M. Daguerre, who published his process in 1839. A copper plate, one surface of which had been silvered and highly polished, was fumed with iodine, then exposed in the camera and developed with vapor of mercury, and fixed in a solution of hyposulphite of soda. The solvent action of hyposulphite of soda on the silver haloids was discovered by Sir John Herschel. This is briefly the process as published by Daguerre in 1839. The exposure required in the camera was about fifteen minutes. Niepce and Daguerre had formed a partnership to prosecute their researches together, so that some of the credit of having invented the daguerreotype process belongs to Niepce.

Soon after this, however, by the addition of bromine to the iodine by Goddard (1840) and chlorine by Claudet (1841) the plates were made very sensitive. We find Dr. Draper in New York in the year 1840 making daguerreotype portraits in from twenty to ninety seconds. M. Fizeau discovered that by treating the daguerreotype with double hyposulphite of soda and gold it was made more permanent and very much more beautiful.

**Fox Talbot and the Calotype Process.**

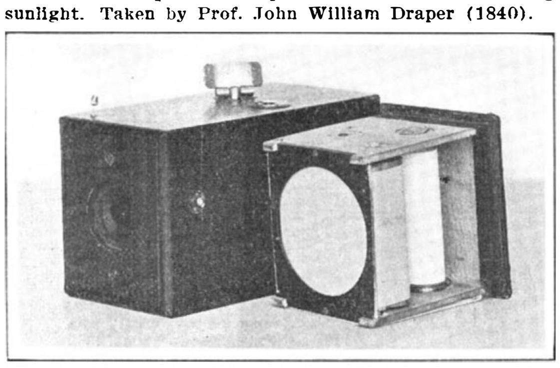
Next came the Calotype or Talbotype, the invention of Mr. Henry Fox Talbot. This may be regarded as one of the most important inventions in photography, for it introduced the photographic negative from which an unlimited number of prints may be made. Talbot's process was published in 1840. A solution of nitrate of silver was prepared, brushed over a sheet of paper, and dried. Then the paper was dipped in a solution of iodide of potassium, washed in water, passed between blotting paper, and dried. This was called iodized paper.

When the paper was required for use, it was washed with a solution of nitrate of silver fifty grains, water one ounce, acetic acid one sixth of an ounce. This was called "Solution A."

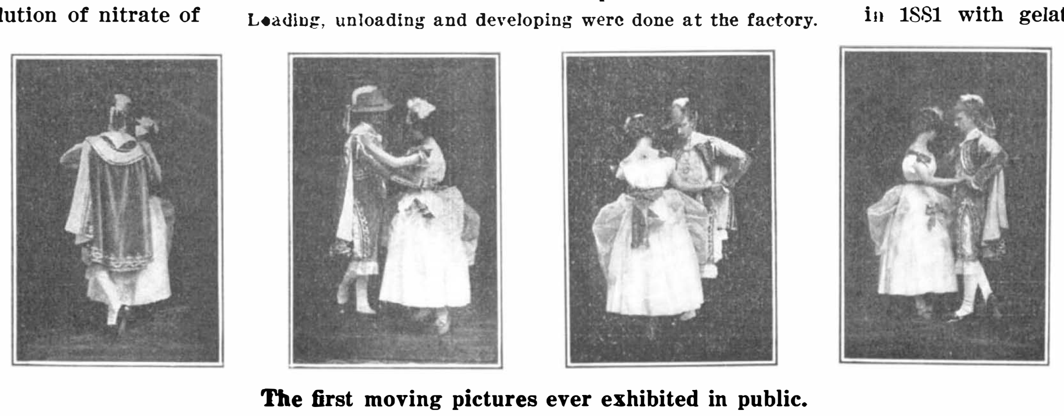
"Solution B" was a saturated solution of gallic acid in cold water. The two solutions were mixed in equal parts, just before using. Talbot called this "gallo-nitrate of silver."


**The first photograph of a human face.**

A portrait of Miss Dorothy Catherine Draper, taken in America. It required an exposure of 6 minutes in strong sunlight. Taken by Prof. John William Draper (1840).


**The first kodak (1888), showing roll-holder and roll film for 100 exposures.**

Loading, unloading and developing were done at the factory.


**The first moving pictures ever exhibited in public.**

They were made by Henry Heyl and were projected on a screen before 1,600 people in Philadelphia in 1870.

The iodized paper was treated with this solution and again dried. The paper was then exposed in the camera and developed with the gallo-nitrate of silver and fixed in hyposulphite of soda. Talbot found later that, by waxing, the paper negative was rendered more translucent, so that it gave better results in printing.

**Wet-collodion Negative and Albumen Silver Print.**

The use of collodion as a vehicle to hold the silver haloids upon plates originated with Frederick Scott Archer in 1850.

Pyroxyline is dissolved in a mixture of ether and alcohol; soluble iodides and bromides are added to this. The mixture is flowed over a glass plate and allowed to set, and then immersed in a bath of silver nitrate. This plate after exposure in the camera is developed with acidified ferrous sulphate or pyrogallic acid.

This process was used almost exclusively for making both negatives and positives on glass for many years, but its use is now very limited except in the photo-mechanical processes.

Blanquard-Everard introduced albumen paper into photography in 1848, after Claude Nicéphore Niepce de St. Victor had shown that good negatives could be made by the use of albumenized potassium iodide, sensitized with silver nitrate on glass. Gray invented the collodion process in 1850, which only one year later was brought to perfection by Fry and Scott Archer. Lemercier, Barreswill, and Davanne invented photo-lithography in 1852. After Henry Fox Talbot introduced the chrome gelatine process, it was but a step for Paul Pretsch to obtain the printing plates by electrotyping swelled gelatine negative (1845), and thus to invent heliography. Talbot's work also inspired the French engineer Alphonse Louis Poitevin to use the chromate gelatine process for devising the modern carbon process in 1855.

**Printing-out Papers.**

Printing-out papers are made by coating paper (usually enameled) with an emulsion composed of gelatine, chloride of silver, with more or less free nitrate of silver. Most of them are faced with collodion. The process was first worked out successfully by George Wheaton Simpson in 1861 with collodion, and by Abney in 1881 with gelatine. The newer developing papers, one of the most successful of which is the invention of Dr. Leo H. Baekeland, have all but superseded the printing-out papers.

**The Evolution of the Carbon Process.**

Carbon printing, in the form now in use, is the result of the action of many minds, and the honor of its discovery cannot be ascribed to the ingenuity of any one person. It may be traced back as follows: Mungo Ponton in the year 1839 discovered that white paper treated with a

(Concluded on page 560.)

Charles Wheatstone, a great English physicist, who was a pioneer worker in telegraphy.

# Communicating Over Great Distances

## The Invention of the Telegraph, Telephone and Wireless Telegraphy

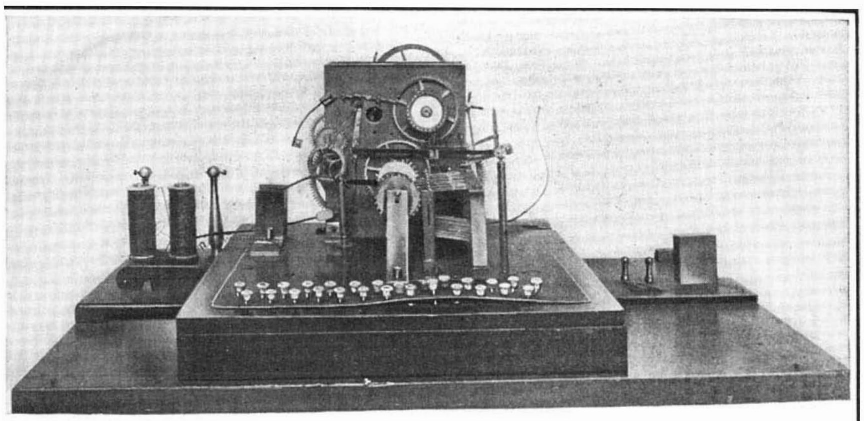
## A Record of Achievement from Morse to Marconi

Sir William Thomson (later Lord Kelvin) inventor of the siphon recorder.

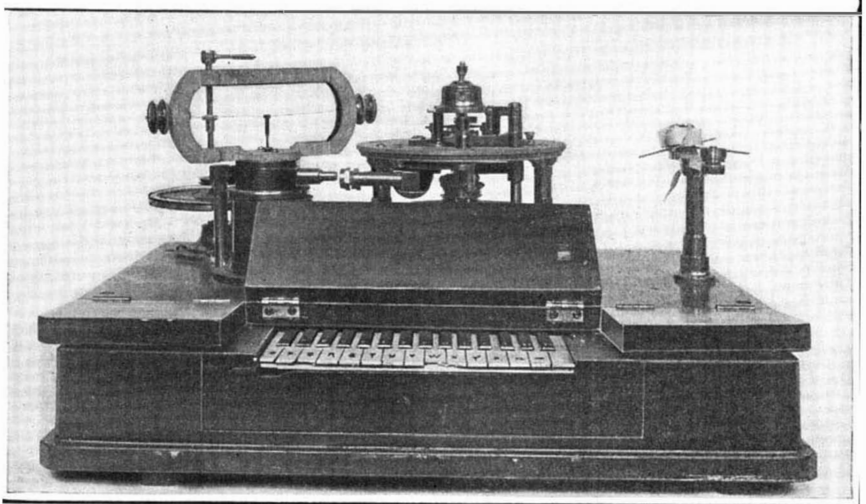
THE SCIENTIFIC AMERICAN came into existence with the dawn of telegraphy. The pioneer discoveries in electro-magnetism had been made by Oersted, Ampère, Arago, Barlow, Sturgeon, Faraday, and Henry. Without them Morse could not have created the telegraph, as we Americans know it. The same may be said of Wheatstone in England, and of pioneers in other countries. Europeans are not willing to concede to Morse the credit of having invented the telegraph, and Americans are not willing to concede to Europeans the credit of having anticipated Morse. As a matter of fact, the invention of the telegraph, like most great inventions, does not belong to any one man or any one country. It grew with scientific knowledge. To Morse undoubtedly does belong the credit of developing the commercial side of the telegraph, as we know it. He, in conjunction with Vail, worked it out on a practical scale, perfected details, invented the Morse alphabet, and last, but not least, succeeded after a great amount of trouble and many disappointments in obtaining the support of Congress toward making it a national enterprise.

After the instruments had been brought to something like commercial perfection, the next important advance was multiple transmission. In 1853 Gintl of Vienna and Frischen and Siemens and Halske independently experimented with apparatus intended to transmit simultaneously from both ends of the same line. While the solutions proposed by these inventors were mechanically sufficient for the purpose, they overlooked an important factor which had not before been considered important in land telegraphs—the electro-static capacity of the line. This difficulty was first successfully overcome by Stearns of Boston in 1871, at a time when duplex working was fairly common. The chief workers in this field were Gintl, Frischen, Siemens and Halske, Preece, Farmer, Nystrom, Maron, Winter, Stearns, and Muirhead.

The problem of how to send two messages in the same direction being solved, the transmission of four messages simultaneously over the same line was attacked. This seems to have been first proposed by Stark of Vienna in 1855, and subsequently worked at by Bosscha, Kramer, Mason, Schaak, and others. But the first to obtain satisfactory results was Edison, who invented his method in 1874. The principle embodied in the quadruplex is that of working over the line from each end with two currents, that differ from each other in strength or nature, so that they will affect only instruments adapted to respond to just such currents and no others; and by so arranging the receiving apparatus as not to be affected by the currents transmitted from its own end of the line. Thus by combining instruments that respond only to variations in the strength of currents from the distant station with instruments that respond only to the change in the direction of current from the distant station, and by grouping a pair of these at each end of the line, the quadruplex is the result. Four sending and four receiving operators are kept busy at each end, or eight in all. Aside from other material advantages it is estimated that at least from $15,000,000 to $20,000,000 has been saved by the Edison quadruplex, merely in the cost of line construction in America.

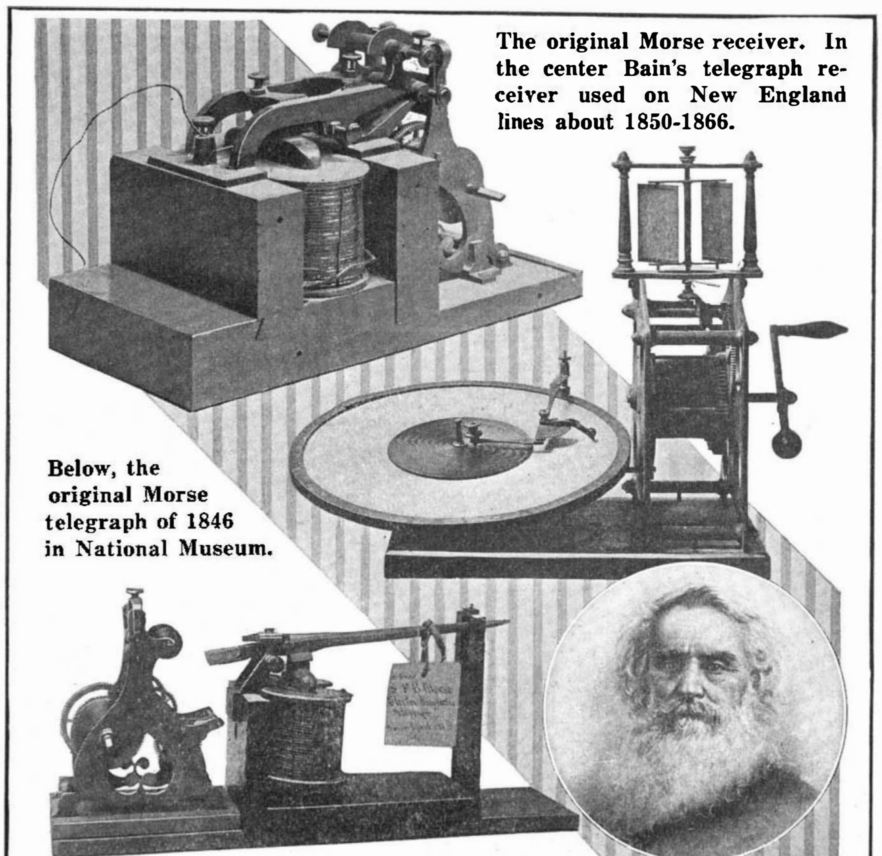


Grandfather of the stock ticker. Original Hughes printing telegraph.



Photographs by C. H. Claudy

The original printing telegraph of R. E. House.



The original Morse receiver. In the center Bain's telegraph receiver used on New England lines about 1850-1866.

Below, the original Morse telegraph of 1846 in National Museum.

Samuel F. B. Morse, his telegraph and that of Bain.

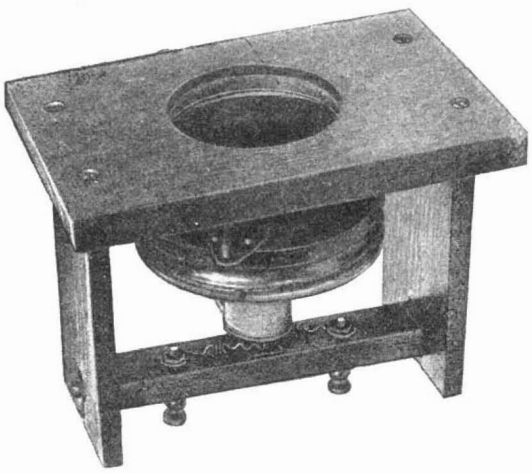
Another system of multiple transmission was proposed by Moses G. Farmer of Salem, Mass., in 1852, in which by a commutating arrangement the main line was put in rapid succession in contact with a series of branch wires by proper connection at the sending station and two communicators worked in unison. It was then proposed to divide the transmitting capacity of the main line wire among a number of branch wires, so that the messages might go over all of these at the same time. A similar arrangement was proposed by Meyer and shown in operation at the Vienna exhibition in 1873. The same principle is adopted in Delaney's telegraph.

Although the mere extension of telegraphs from land to submarine lines can hardly be called invention, yet very many new problems presented themselves for solution in this extension. The application of Stearns' duplex method to submarine telegraphs involved peculiar difficulties on account of the very large capacity of the line, and in the more important cables, the length of the circuit. The credit of having completely overcome these difficulties for submarine cables is mainly due to Dr. Muirhead of London. The electro-static capacity of the line is such that signals could not be so instantaneously transmitted as they were on land lines. Moreover, there was no opportunity of using relays so as to shorten the longer lines. Then there were the evident mechanical difficulties of manufacturing and of submerging a cable in deep water. The experiments in short lengths in the English Channel and elsewhere had proved successful and had aroused the interest of American and English business men in a transatlantic cable. It is due to the persistence of Cyrus W. Field that we owe the laying of the first transatlantic cable in 1866. The Anglo-American Telegraph Company was organized to undertake the task. With the aid of the "Great Eastern" a submarine cable was laid between Valencia, Ireland, and Trinity Bay, Newfoundland, between July 7th and August 4th. It is needless to recount the early success, the cessation of intercourse due to accidents and the final resumption of communication. They are now matters of common knowledge.

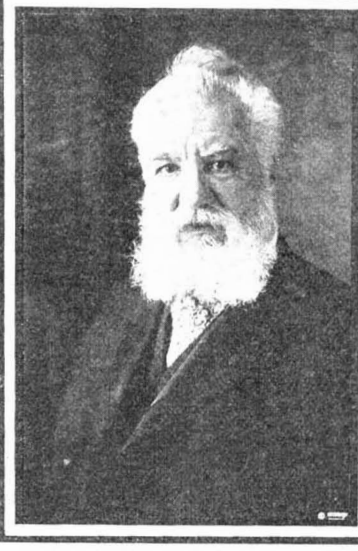
The laying of long cables brought out the fact that existing telegraphic apparatus was not sensitive enough for rapid signaling. Thomson, later Lord Kelvin, overcame the difficulty by inventing the mirror galvanoscopic receiver, which invention he followed later by his siphon recorder, probably the most sensitive recording telegraph known. Improvement in methods of working cables soon followed, among which in the early days, probably the most notable, is the introduction of condensers between the ends of the cable and the earth.

A few years ago, John Gott of Hove,

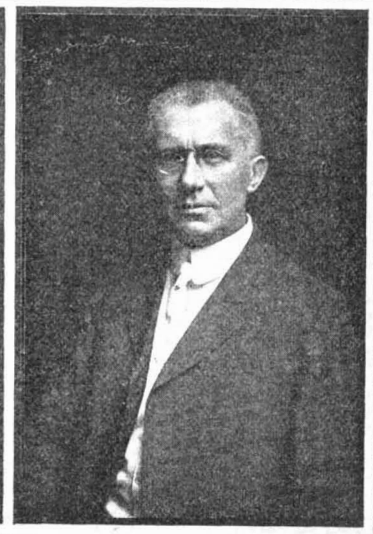
Bell's original Centennial iron box receiver.



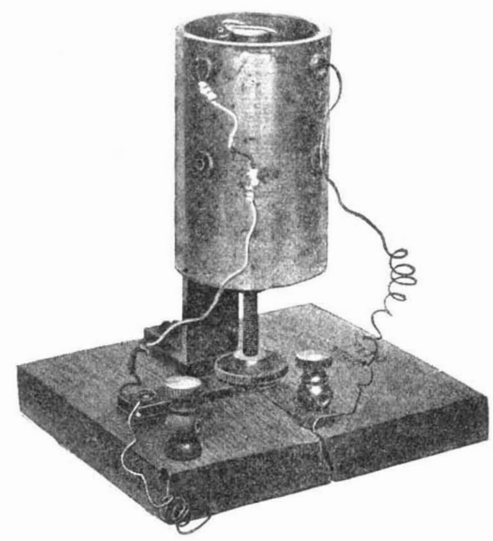
Alexander Graham Bell.



Emile Berliner.



The first instrument made and used by Bell.



Copyright Harri & Ewing

Sussex, England, invented a new method by which Morse signals can be sent through long submarine cables with some approach to the facility enjoyed in the transmission of the familiar dots and dashes on overland circuits. The method obviates retransmission at the cable or land ends, and eliminates the siphon recorder, substituting for it an ordinary Morse recorder or sounder.

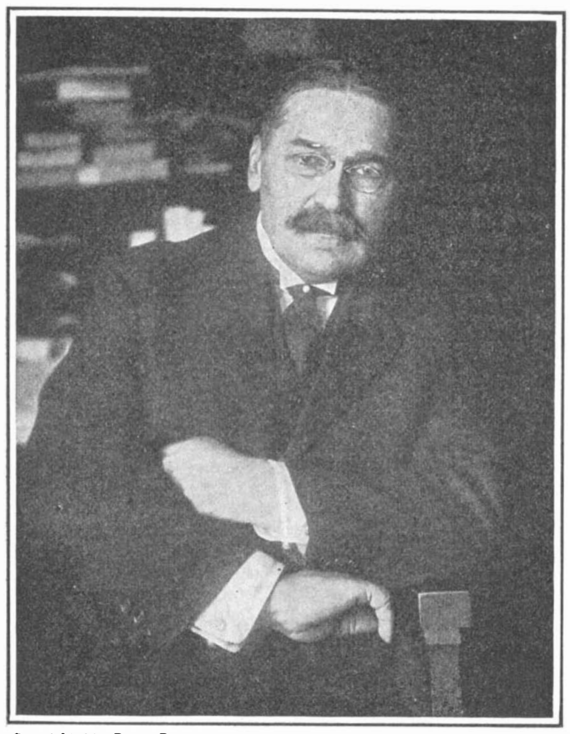
Successful long distance cable working has involved the use of a reversing key, to send two element signals by changing the direction of the current. In Gott's method the change in direction of the current is effected after each signal by the use of a polarized relay through which the cable is discharged, and the path of the current reversed for the next sending signal. With this system it is possible for an operator at San Francisco to communicate directly with London. While the method does not phenomenally increase the actual speed of transmission, it makes submarine telegraphy more accurate, effective and uniform.

**High Speed and Printing Telegraphs.**

From the dawn of electric telegraphy inventors have been at work filling the patent records with printing telegraph schemes, some brilliant, some stupid and nearly all useless. Out of several hundreds of printing telegraphs invented prior to the beginning of the twentieth century, only the Hughes and Baudot and the stock tickers achieved any real success. With the stock tickers the problem to be solved was comparatively easy. They were required to work only over distances of a few miles. High speed was desirable, but not absolutely necessary. One man by playing on a keyboard could transmit messages to a considerable number of subscribers, and there was no necessity to deliver the messages, no need to count the number of words in each message, to sign and time the messages or cut up the tape and paste it on telegraph blanks, no need to keep copies of the messages for record, or put them in envelopes or address the envelopes and send them out by messenger. The conditions were of the simplest character, and the consequence has been that the stock tickers long ago reached their full development. One of the earliest of these stock tickers was that of Dr. S. S. Laws, who patented at the end of 1866 his gold reporting telegraph. E. A. Callahan, an ingenious printing telegraph operator, saw that there were unexhausted possibilities in the idea, and his foresight and inventiveness made him the father of the ticker, in connection with which he was thus, like Laws, one of the first to grasp and exploit the underlying principle of the central station as a universal source of supply. Callahan transformed his indicator into a ticker that would make a printed record. At this juncture Edison entered the field. In collaboration with Pope, he invented a one-wire printer. Financed by Gen. Lefferts he started to improve the stock ticker. The well-known universal ticker in widespread use in its day was one result. Since then the stock ticker has enjoyed the devotion of many brilliant inventors—G. M. Phelps, H. Van Hoevenbergh, A. H. Knudson, G. B. Scott, S. D. Field, and John Burry —and remains in extensive use as an appliance for which no substitute or competitor has been found. It is significant of Edison's work, now dimmed and overlaid by later advances, that at the very outset he recognized the vital importance of interchangeability in the construction of this delicate and sensitive apparatus.

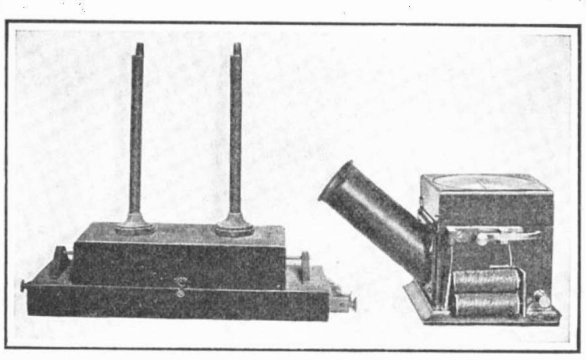
The only successful page printing telegraphs in very extensive use to-day in Europe are still nothing but glorified stock tickers, in the terms of Mr. Donald Murray, himself a distinguished inventor in this field. In a paper which he published some years ago he summarized the whole situation excellently as follows:

"The Hughes instrument prints on a tape, and the speed is limited by the manual dexterity of the operator and the keyboard. The gain compared with the Morse key is small. The Baudot printing telegraph, which is largely used in France, and which connects Paris with nearly all the European capitals, may be described as a multiplied Hughes, as it is equivalent to four and even six Hughes instruments working over a single wire. It is exceedingly ingenious, highly practical, and gives admirable service within its limitations; but it is not a fully developed prnting telegraph system because it is not provided with a typewriter keyboard for transmitting, and it does not print the messages in page form. It prints on a tape, and it does not save labor to an appreciable extent, compared with the Morse key. Its great virtue is that it saves wires. In fact, in France and some neighboring countries it may be said to have met the want that has been supplied in Anglo-Saxon countries by the Morse quadruplex. The Morse quadruplex and the Baudot might be described as the second stage in the development of the modern telegraph. The third and final stage of completely developed machine telegraphy has only been reached after 1900. Within this brief period there has arisen the Pollack-Virag, Buckingham, Rowland, Murray, Morkrum, and Siemens and Halske high-speed telegraph systems. Telegraph companies and governments have never been kindly disposed toward machine telegraphy."



Copyrighted by Brown Bros.

**Prof. Michael I. Pupin, inventor of the load coil that made transcontinental telephoning possible.**



**Model of the Reis telephone in the National Museum of Washington.**

**Alexander Graham Bell and the Telephone.**

The invention of the telephone constitutes one of the greatest advances that have been made in the art of communicating over great distances. It is well known that sound is transmitted through the air from speaker to hearer by means of waves, condensation and rarefaction, which affect the drum of the ear. As early as 1831 Wheatstone showed that these waves could be transmitted from one place to another at a moderate distance through wooden rods and afterward conveyed to the air by the vibrations given to the air by the end of the rod. Similarly, vibrations given to one diaphragm to produce the corresponding vibrations in another diaphragm at a distance by means of electric currents was the problem of the electric telephone. The first to propose this appears to have been Charles Bourseul, who in 1854 suggested the use of two plates, one at the transmitting station, which, by the varying pressure of the air due to the sound waves, would open and close an electric circuit while the other was to be acted on at the receiving station by an electro-magnet through which the electric currents passed.

In 1861 Philip Reis of Friedrichsdorf disclosed in a lecture an instrument which he called a telephone, for the production at a distance of music and human speech. The apparatus consisted of a flexible membrane forming one side of a box, with which by means of a mouthpiece the sounds could be directed. This instrument was made to open and close an electric circuit at each vibration. At the receiving end, an electro-magnet consisting of a thin rod of iron surrounded by a coil was placed. The successive interruptions and closings of the electric circuits took place in accordance with a discovery made by Dr. Page of Salem, Mass., in 1837.

There is no good reason to suppose that Reis's telephone ever talked, although it probably did transmit musical sounds. His method could not be successful for speaking simply because speech has more characteristics than pitch. To reproduce not only corresponding vibrations. but also loudness and quality of the sounds, a transmitter and receiver were required which did not depend for their action on such interruptions of the current, but which varied the current in a pulsatory manner similar to the variations of pressure on the diaphragm due to the waves.

It was not until Alexander Graham Bell produced his apparatus in 1876 that these requirements were met. That he thoroughly understood his problem is abundantly clear from the patents and records of his early experiments. Without re-

*(Concluded on page 386.)*

**Marconi and one of his early wireless sets.**

# The Patent Office and Invention Since 1845

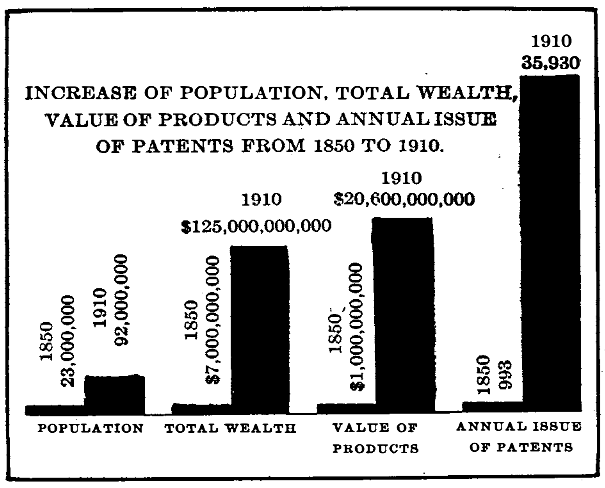
## How the Government Has Kept Pace With the Inventor

By William I. Wyman

IN 1845, the birth year of the SCIENTIFIC AMERICAN, the present patent system was nine years old. In 1836 the Patent Office was placed on a distinct basis, the system reorganized and the examination or American method of searching patents inaugurated.

**Thomas Jefferson Was the First Commissioner of Patents.**

The American patent system was founded under the act of 1790. Under this act the Secretary of State,




the Secretary of War and the Attorney General constituted a board to consider all applications for patents. Thomas Jefferson, the first Secretary of State, was in effect the first Commissioner of Patents and the first Examiner. It is said that he personally examined into and determined the patentability of every application filed during his first years in office as head of the State Department. The grant of a patent then was not only a procedure of exceeding dignity, being signed by the President, the Secretary of State and the Attorney General, but was issued with some reluctance. Only three patents were permitted to see the light of day in 1790.

From this modest beginning, the business of the patent system grew slowly, but steadily. From 1790 to 1802 it required but one State Department clerk to perform all the clerical work pertaining to the Patent Office, the entire records of which were contained in a dozen pigeonholes. Up to 1836, about 10,000 patents

| | Patents, Total Issued to that year | Total Wealth | Per Capita | Population | Value of Products |
|---|---|---|---|---|---|
| 1850. | 7,000 | 7 Billion | $308 | 23 Million | 1 Billion |
| 1860. | 27,000 | 16 " | 514 | 31.4 " | 1.885 " |
| 1870. | 98,000 | 27* " | 750* | 38.5 " | 3.400 " |
| 1880. | 223,000 | 43 " | 870 | 50 " | 5.3 " |
| 1890. | 419,000 | 65 " | 1,036 | 62.6 " | 9.4 " |
| 1900. | 640,000 | 88½ " | 1,165 | 76 " | 13 " |
| 1910. | 945,000 | 125* " | 1,400* | 92 " | 20.6 " |

*Estimated.

were granted. In that year, the Patent Office became an independent bureau, headed by a commissioner, assisted by *one* examiner and six other subordinate clerks and employees. While the reorganization gave the Office a dignity and standing it did not have before, still the force provided to cope with the pressing demands of inventors does not now appear to be excessively large. And yet critics, whose sense of economy was more acute than were their gifts of imagination, decried the sheer waste entailed by an organization so extravagant in men. But applications came pouring in, and in the following year the examining corps had to be doubled by the appointment of an additional examiner, and in 1839 the position of two assistant examiners was created to keep pace with the growing business.

The act of 1793 was the only one which provided for the grant of a patent without examination. In 1836 the modern examination system was instituted, by which a search through patents and publications was made to determine the question of novelty. This act also for the first time made a positive requirement for the inclusion of a claim in the specification in the following terms:

"He [the inventor] shall positively specify and point out the part, improvement or combination which he claims as his own invention or discovery."

**The Early Days of the Present Patent Office.**

In 1836 the erection of the Patent Office was begun; the building was finished in 1840. This original structure forms the F Street wing of the present building. In 1845 the patent system was well on its way and the Office properly housed, with an official force of one commissioner, two examiners, and two assistant examiners. In that year, 1,246 new applications were filed, besides many caveats, and the work was becoming too heavy for this limited force to handle effectively. This condition became and continues to be chronic.

Even as early as 1850, only five years after the founding of the SCIENTIFIC AMERICAN and but fourteen years after the reorganization of the Patent Office, American inventions were numbered among the most notable produced. In 1857, this country issued over one third more patents than Great Britain, which at that time had a substantially greater population. In that year, the United States with a population of 23,000,000 issued 2,910 patents, Prussia with almost 17,000,000 issued 48, while Russia, with 70,000,000 population, issued 24 patents. Commissioner Holt, in his annual report for that year, in reviewing the statistics, grows eloquent and philosophizes thus:

"As the light of liberty waxes dimmer, so does the inventive genius flag and dull apace, until finally, amid the darkness of the political night which broods over Eastern lands, it is utterly extinguished."

**The Ante-Bellum Period of American Invention.**

During this decade, the one immediately preceding the civil war, the stimulating influence of invention upon industry became noticeably apparent. Southern New England was tending to become a gigantic workshop and the character of entire sections of New York and Pennsylvania and Ohio radically changed from agricultural to industrial communities. The invention of the sewing machine—the greatest labor-saving device of the ages—was of itself a tremendous stimulus, and the opening up of the West through the railroad meant activity in iron production and the basic engineering industries. The reaper and the thresher made the opening up of the West profitable and the inventions in firearms, machine tools, locks and labor-saving devices and textile machinery initiated new industries and accelerated the growth of the country by leaps and bounds. By the time the civil war broke upon the country, only a quarter of a century after the inauguration of the present patent system, and in spite of the pre-eminently agricultural character of her pursuits, this country gave every evidence that she was to be among the first of the industrial nations.

**After the Civil War.**

The distracting period of the civil war over, activity in enterprise increased energetically, and in the year after the civil war closed there were filed in the office over three times as many applications as were filed in 1861. During the war, the Bessemer process was developing, and the influence of this most stimulating of inventions, which inaugurated the age of steel and our present intensive industrial era, became felt not long after its close. Then began a period of true national expansion—the further developing of the West, with strenuous enterprise in reaching out with new railroads, building of steel mills and locomotive works—marking an inflation of energy, industry and finance, which culminated in the severe panic of 1873. The country paused for a little while and took account of stock at the great Centennial Exposition in 1876. The wonders of our

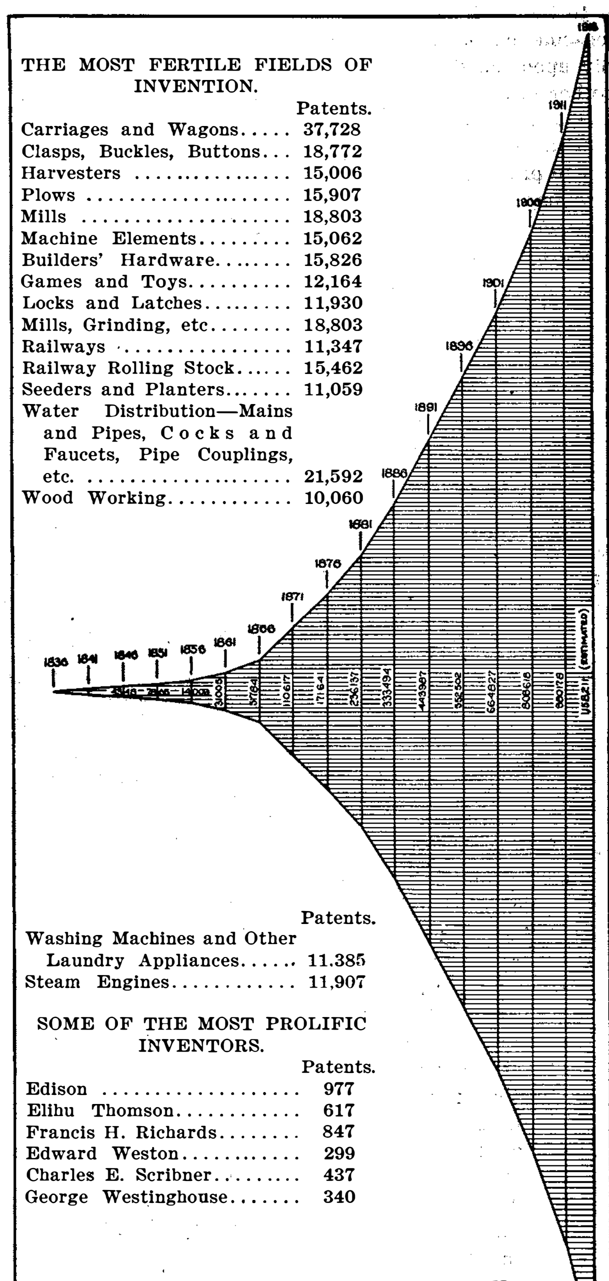
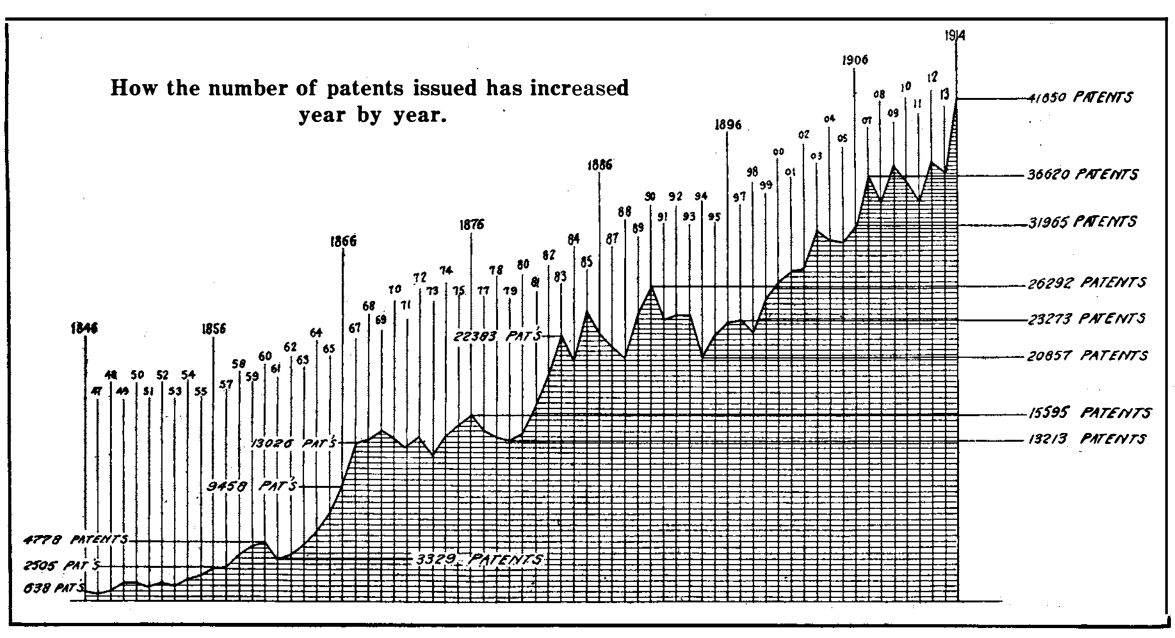



Diagram showing ratio of increase of United States patents for each five years.

material advance, practically all of which were induced by invention, such as the Corliss engine, the textile machines, woodworking tools, machine tools, the sewing machine, hydraulic machinery and various kinds of automatic appliances, were there spread out for inspection to demonstrate the ingenuity of the American inventor and the intimate relation existing between him and what was making American development.

The period from 1865 to 1880 gave inkling of the dawn of a radically new era. The electrical age was prognosticated in the dynamos of Gramme, Siemens and Brush, the Bell telephone and the arc lamp. But they left no impress upon industry or the social life of the time until the next period got into swing. From 1867 to 1879, the annual number of applications filed remained stationary and averaged around 20,000 per year, but about the time specie payments were resumed, the country appeared to take on a new lease of life.



In 1867, 21,276 applications were filed, and in 1879, 20,059; in the next year (1880) the number increased to 23,012, and in 1889 reached 40,575, more than double the number filed ten years before. In that decade the country literally jumped forward and inventive ingenuity reached the golden age of its activity. For more exhaustive treatment of this decade the reader is referred to the editorial page of this issue.

The present commissioner, Hon. Thomas Ewing, in his endeavor to conserve the vast benefits the Patent Office has conferred upon the American people, has instituted several reforms to overcome some of the abuses which have gradually crept into the practice and grown by degrees to menacing proportions. Among these is the tendency to initiate unnecessary interferences. They are now being reduced in number wherever it is possible without injury to anyone's rights, and thus avoid litigious proceedings and lessen the financial burden upon the inventor. They are a source of delay and expense to the applicants and constitute an involved and burdensome handicap which has sometimes been laid heavily upon the shoulders of a meritorious inventor.

Another innovation concerns the rights of the public at large and relates to an abuse of privilege on the part of those inventors who desire to delay the issue of their patents to prolong their life. In court practice, no matter how important the stake, an issue is soon reached upon which the case may go to trial. But until the famous decision in *ex parte* Miller and the issuance of the orders by the present commissioner, by which every dilatory prosecuted case is made special and is treated by him personally, through his supervisory authority, such coming to an issue could be delayed indefinitely. This, the greatest of all abuses of privileges on the part of applicants, is in a fair way to be effectively remedied.

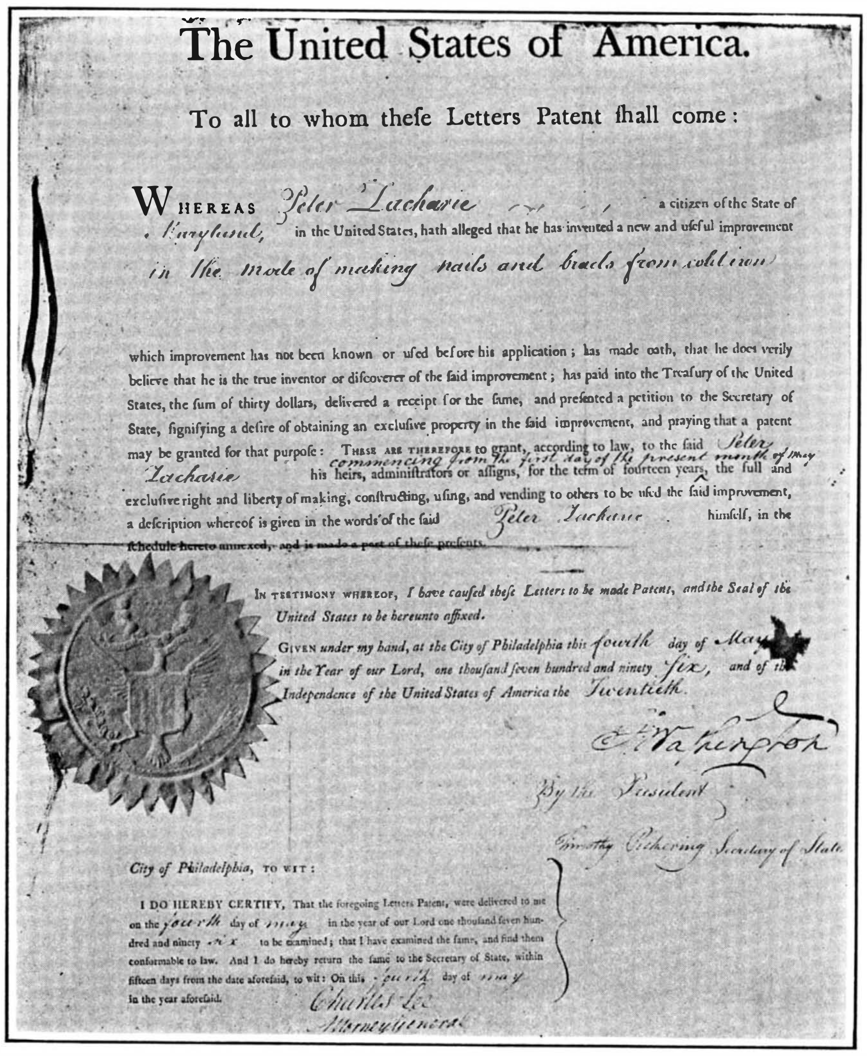
**The Advent of the Hired Inventor.**

The larger concerns have in connection with their patent departments or in association with them research laboratories with a corps of highly trained engineers and technical and scientific assistants. Every improvement of a patentable nature, if of proved utility or possible merit, becomes the subject matter of an application, not only for the monopoly that a patent may bring, but also as a protection in its manufacture and as a matter of record. The patent department advises the technicians whether a proposed device may be patented, or whether it infringes an existing patent, and also appraises the validity and value of patents offered to the company for sale. The experimental department will try out new ideas or develop them to some conclusion. Many of the big things now come through these organizations, for frequently in the evolution of an art, an instrumentality may be so complex, require the expenditure of so much skill and money to develop and demonstrate, that only a company with large resources is able to handle the proposition. Thus, the General Electric Company took several years, plus an expenditure of a few million dollars, to develop the Curtis turbine. It is by no means uncommon for a promoter to spend over $100,000 to develop a process or apparatus so it will be marketable. Edison, who, if not incorporated, is a host in himself, frequently spent thousands upon thousands in investigations and has made experiments by the hundreds before he was in a position to announce results. There are some devices which are so intricate in design, notably type setting and casting machines, that anywhere from a quarter to one million dollars may be expended in construction and improvement, in trials and changes, only to prove eventually, what could not possibly be determined in advance, that it could not meet the various requirements demanded in commercial practice. Mark Twain sank his personal fortune of several hundred thousands in a typesetting device, probably the most intricate bit of mechanism ever devised, because, while the machine did everything it was designed to do, it was too intricate to be understood by the ordinary mechanic.

Then again, the device may be simple enough, its merits sufficiently obvious, but it may require more business acumen, push and advertising to introduce it than would be required to market an article of staple and competitive character, or sometimes, no character at all. A well-known instance of this inertia on the part of the public is the case of a certain safety razor, which required prodigious efforts on the part of its promoters to eventually get the public to use what appeared to be a self-evident filling of a long-felt want. No inventor can afford to create without the protection of the patent laws, because the labor and expense he is placed under preliminary to establishing the utility of his invention becomes a fixed charge and the very means to handicap him against a piratical competitor, who can start without such a burden.

**The Infinite Possibilities That Lie in Invention.**

In 1844, Commissioner Ellsworth, contemplating the 13,500 patents granted up to that year, over 500 of which were issued in the year 1843, and apprehending a cessation of all endeavors in the field of invention, uttered this prediction in his official report: "The advancement of the arts, from year to year, taxes our credulity and seems to presage the arrival of that period when human improvement must end." The commissioner could well marvel at the astounding advances made in labor-saving devices during his own life time, but what would have been his mental state could he have been endowed with prophetic vision and have foreseen but a fraction of the inventive activity which has taken place in a man's lifetime from the date of his utterance? The number of patents now is over a million, the annual issue is more than three times the number of all the patents granted up to his day, and the examining corps has increased from four to almost four hundred without being able to keep pace with the ever growing tide of new work. It is estimated that the value of American manufactures attributable directly or indirectly to patentable inventions amounts to the enormous total of more than twenty billion dollars, which is about four times the value of


The United States of America.

To all to whom theſe Letters Patent ſhall come:

Whereas Peter Zacharie a citizen of the State of Maryland, in the United States, hath alleged that he has invented a new and uſeful improvement in the mode of making nails and brads from cold iron

which improvement has not been known or uſed before his application; has made oath, that he does verily believe that he is the true inventor or diſcoverer of the ſaid improvement; has paid into the Treaſury of the United States, the ſum of thirty dollars, delivered a receipt for the ſame, and preſented a petition to the Secretary of State, ſignifying a deſire of obtaining an excluſive property in the ſaid improvement, and praying that a patent may be granted for that purpoſe: These are therefore to grant, according to law, to the ſaid Peter Zacharie his heirs, administrators or aſſigns, for the term of fourteen years, commencing from the first day of the present month of May the full and excluſive right and liberty of making, conſtructing, uſing, and vending to others to be uſed the ſaid improvement, a deſcription whereof is given in the words of the ſaid Peter Zacharie himſelf, in the ~~ſchedule hereto annexed, and is made a part of theſe preſents.~~

In testimony whereof, *I have cauſed theſe Letters to be made Patent, and the Seal of the United States to be hereunto affixed.*

Given *under my hand, at the City of Philadelphia this* fourth *day of* May *in the Year of our Lord, one thouſand ſeven hundred and ninety* six, *and of the Independence of the United States of America the* Twentieth.

G. Washington

By the President

Timothy Pickering Secretary of State

*City of Philadelphia,* to wit:

I do hereby certify, That the foregoing Letters Patent, were delivered to me on the fourth day of may in the year of our Lord one thouſand ſeven hundred and ninety six to be examined; that I have examined the ſame, and find them conformable to law. And I do hereby return the ſame to the Secretary of State, within fifteen days from the date aforeſaid, to wit: On this fourth day of may in the year aforeſaid.

Charles Lee
Attorney General

**The first patents were signed by President George Washington.**

*all* taxable property in the United States at the time Commissioner Ellsworth made his report.

It has been said that the single invention of producing steel by the Bessemer process doubled, directly or through its influence, the world's wealth in the third of a century after its introduction. The forcing effect of patent protection on industry is well illustrated in the cases of such branches as are directly based upon invention, and which did not exist or were in a negligible state in 1880.

*Statistics for the Year 1909.*

SOME OF THE INDUSTRIES CALLED INTO EXISTENCE SINCE 1880.

| | Estab-'ments | Persons engaged | Output annually | Value added by mfr. |
|---|---|---|---|---|
| Phonographs...... | 18 | 5,928 | $11,728,000 | $8,667,000 |
| Photo Apparatus... | 103 | 6,596 | 22,561,000 | 15,853,000 |
| Cash Registers.... | 50 | 9,491 | 23,708,000 | 20,156,000 |
| Typewriters....... | 89 | 12,101 | 19,719,000 | 15,642,000 |
| Autos............ | 743 | 85,359 | 249,253,000 | 117,506,000 |

The figures in the last column are particularly significant as they show the very high percentage added to the cost of the raw materials by the process of manufacture, i. e., by the knowledge, skill and labor of the producers.

More astounding are the figures relating to the electrical industries, including telephony, central station lighting and power, and electric railways, the latest figures available showing an investment in the United States alone of seven billion dollars, annual gross revenue or sales of over a billion, in which three quarters of a million men were engaged, at an annual pay-roll of over three hundred and fifty million dollars. These industries were either non-existent in 1880 or in their incipient stage at that time. Their origins and every advance therein were directly founded on inventions, every one of which is patented and of record in the Patent Office.

**The Trend of Invention.**

The activity of the different classes in the Patent Office from time to time reflects accurately the changes which constantly pass in the world of industry and the applied arts. The basic pursuit in this country always being the tilling of the soil, patents for agricultural implements have occupied a prominent position, both in numbers and importance throughout its history. The invention of the sewing machine initiated a period of great activity in a new art, while the telephone let loose a flood of inventions for adaptations and improvements. The new electro-chemical industry came into being about the middle of the eighties and patent activity with relation thereto was high at the same time. The incandescent lamp started the electric age, in whose vortex we still are, and patent concern in all things electrical is still intensive. The rise and fall of the bicycle, the wave of interest in automatic car couplings, the first surgings of activity in aeroplane invention, and the deep concern of the great ingenious to solve the urgent non-refillable bottle problem—all these movements have been reflected in the filing of applications in the Patent Office. In recent years the automobile is establishing records, the arts relating to internal combustion motors, carbureters, gearing, self-starters, accessories, alloy steels and heat treatment of steels being specially active.

The United States has by far the proudest record in the field of invention; whether reckoning by the number of pioneer products, their ingenuity, or their far-reaching effects in the greatest diversity of fields, she easily stands in first place. Particularly in labor-saving devices does she stand foremost. No one in all history has worked so hard to save labor as the Yankee. The greatest of all labor-saving devices, the sewing machine, is his, and outside of textile machinery, practically all the great advances in this department have been of his invention, as witness the cotton gin, the reaper, shoe machinery, typewriter and typesetting machines.

In the field of electricity the American shares pre-eminence with Europeans, and yet the three most signal advances in electrical application are to his credit—the telegraph, telephone, and the incandescent lamp. Since 1880 (the typewriter was invented a few years previously) no revolutionary mechanical invention comparable to those which signaled American ingenuity previously, was devised except the typesetting machine, but in the field of electricity (incandescent lamp, trolley car, electric welding), optics (kinetescope, transparent film) and air navigation (an absolutely new art), he did not remain inactive.

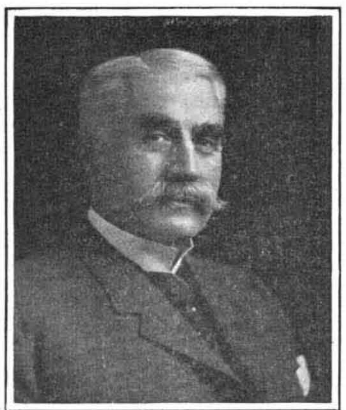
**Some Prolific Inventors.**

Between 1872 and 1900, Thomas Edison had received 742 patents; F. H. Richards, 619; Elihu Thomson, 444; Charles E. Scribner, 374; L. C. Crowell, 293; Edward Weston, 280; R. M. Hunter, 276; Charles J. Van Depoele, 245; and George Westinghouse, 239. Up to 1910 Edison secured 905 patents, of which 713 were electrical. Considering all the patents that are probably pending or in course of preparation, it is estimated that the number of his inventions is greater than 2,000. It is safe to assert that he is the most prolific inventor of all time.

Although Great Britain has more pioneer inventions to her credit involving fundamental operations that underlie all industry, than any other country, the only innovations of pioneer character she has contributed in the last one half century are the basic process for making steel, the steam turbine, and the cyanide process. But the steam engine, the greatest invention of all ages, is hers, and so is the Bessemer process, which inaugurated our present intensive industrial era.

Germany before 1871 was an almost negligible factor in the field of applied science, although she had previously to that date given ample evidence of her vigor in pure science. The adoption of a patent system based upon that of the United States, was an extreme stimulus to invention, and the impetus given to inventiveness is

(*Concluded on page 575.*)



Charles F. Brush, inventor of the modern electric arc lamp.

# Converting Night Into Day

## Artificial Lighting Problems and How They Have Been Solved

### What the Inventor Has Done for Oil, Gas, and Electricity in Illumination

Carl Auer von Welsbach, inventor of the Welsbach system of gas lighting.

When Col. E. L. Drake "struck oil" in Pennsylvania in 1859 he also established the lamp oil industry. As soon as it was found that Pennsylvania had abundant supplies of oil the inventors began to file their applications for oil lamp patents. They began in 1859 itself and kept on for many years. Literally hundreds of lamps were invented. It was no mean problem to burn oil safely and efficiently in a lamp. Circular wicks and flat wicks, single burners and double burners, wicks of peculiar plaiting, were patented to feed the oil in just the right quantity to the burner head by capillary attraction. It is hardly worth while here to trace the course of development of the kerosene lamp. The simplest lamp soon proved the safest, all the more so since laws were passed in almost every country to prohibit the sale of oils with too high a flash point.

Arthur Kitson in 1885 patented a system of feeding the oil under pressure to a chamber where it was heated by the flame of the lamp itself and volatilized. The vapor thus produced was then fed to a kind of atmospheric burner, being automatically supplied by its suction with sufficient oxygen from the air to produce a very hot blue flame. Kitson employed a platinum gauze which was heated by this flame to incandescence, that being a time when the Welsbach mantle had not yet been commercially introduced. The gauze answered well enough for a time; but it became useless when soot was deposited upon its meshes.

But even if Kitson had been able to utilize the Welsbach mantle, his lamp might not have been successful in its early form. It is difficult to mix air with the high-pressure vapor so intimately that carbonization will not result, and a carbonized mantle is robbed of its luminosity. Even when the desired intimacy of mixture is obtained there is difficulty in maintaining it automatically. The difficulty was ingeniously overcome by F. Altmann, among others, who devised an arrangement in which water and oil were vaporized by a burner in a small separate chamber, whereupon the mixture of vapor and steam was fed to a special burner head, supplied with air, and used to heat a Welsbach mantle to incandescence. Such lamps are remarkably economical. They yield three times the amount of light which can be obtained from oil when consumed under ordinary conditions.

The invention of the Welsbach mantle served not only to improve the oil lamp, but also to revive "air gas"—air mixed with volatile hydrocarbons and burned in an Argand burner like ordinary illuminating gas of the present day. When the general extension of coal gas and electricity had practically relegated air gas to the place of an abandoned illuminant the Welsbach mantle gave it a new lease of life. A. I. van Vriesland, Hooker, and De Laitte are among the inventors who improved air gas generating apparatus so that the Welsbach mantle could be effectively employed.

#### The Development of Gas Lighting in Our Time.

Although towns were lighted early in the nineteenth century by gas, it was not until the last four decades that rapid progress was made in gas lighting; for in that brief period there were great improvements both in the manufacture of gas as well as in the methods of burning it. The London Argand burner of 1875 was considered the last word in illumination in its day—something that could not be surpassed. But when the incandescent mantle came, six times as much light was obtained from the same amount of gas. By 1845 most of the burners with which we are familiar had been invented and fairly well standardized. William Murdoch himself, the first man to use coal gas in his house (1779), devised the "cockspur" burner. J. B. Neilson devised the "fishtail" burner. Sir Edward Frankland in 1853 brought out his burner for utilizing the heat of the flame to raise the temperature of the air supply for the combustion of the gas. A similar regenerative system was that of the Rev. W. R. Bowditch (1854). By far the best of these regenerative burners was that of Friedrich Siemens, who came out with his invention in 1879. These ingenious burners, efficient as they were, never succeeded in supplanting the ordinary fishtail and batwing burner, simply because of their initial cost. The Argand burner, too, more than held its own.

It is obvious that these various burners depend for their efficiency on different principles. The ordinary fishtail or flat flame burner must be fed with a gas very rich in carbon particles. In the regenerative burners the temperature to which the carbon particles are heated is raised as high as the material of the burner will permit. It was the effort to increase this temperature and with it the efficiency of the gas flame that led to the evolution of the modern system of incandescent gas lighting.

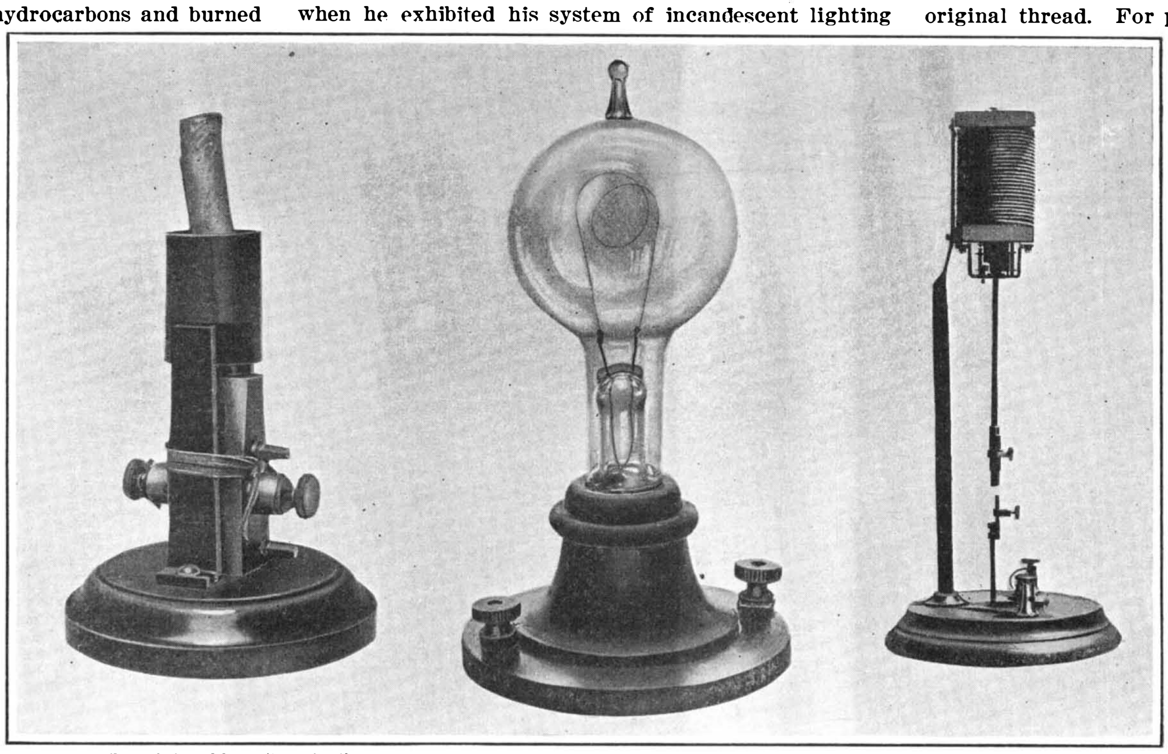
While the principle underlying incandescent lighting —that of raising the temperature of refractory substances to a point where they emit light—is old and may be traced back fully a hundred years, it was not until our own time that it was successfully applied. To be sure, Gillard had tried to use platinum gauze so that he might increase the utility of his water gas, introduced in 1848, but his scheme failed because the platinum was coated with a deposit of carbon in a short time. Bunsen's invention of the burner that bears his name—a burner which produces a very hot, blue, almost non-luminous flame as a result of the mixture of air with gas—really made incandescent gas lighting possible. After that it was easy for Clammond, a Frenchman, to suggest the use of calcined magnesia as a refractory material to be heated by a Bunsen burner. Clammond created a sensation in the early eighties when he exhibited his system of incandescent lighting in London and Paris. He even used something like the modern mantle or stocking, although he called it a basket. What is more, he devised a creditable system of inverted incandescent lighting.

But it was not until Auer von Welsbach, a brilliant Austrian chemist, conducted his study of the rare earths that modern incandescent lighting was created. Although his discovery was to a certain extent accidental, still only a clear-seeing investigator could have seized upon that accident and turned it to practical account. During his spectroscopic study of the rare earths he used the platinum wire in the time-honored way. It occurred to him that he might obtain a more brilliant effect for his momentary purpose if he immersed a piece of cotton in the solution which he was investigating. To his astonishment, he found that while the thread was burned completely away, the salt of the solution into which it had been dipped still remained in the form of the original thread. What is more, that salt continued to glow with a wonderful brilliancy. Another experimenter might have passed the discovery by and continued with the main investigation. Welsbach realized the meaning of that brightly glowing thread, which was no longer cotton, but a metallic oxide. He set about the task of devising a fabric of cotton which could be used to soak up a solution of rare earth (zirconium, lanthanium, yttrium), and after much experimenting arrived at a mantle impregnated with thorium oxide mixed with other oxides. The really serviceable mantle came when he found that a little ceria must be added to the thoria in order to obtain a mantle capable of shedding the most light. All this investigation was conducted in the middle of the eighties.

#### The Evolution of the Welsbach Mantle.

When it was placed upon the market over twenty-five years ago the Welsbach mantle consisted of a knitted hose-like fabric of cotton, which was soaked in a liquid called lighting fluid—a solution of thorium and cerium nitrates in water. The cotton was burned out, leaving the thorium and cerium in the form of an ash, which was then hardened and shaped. To form a protective coating during shipment the mantle was dipped in a collodion solution.

The ash of the finished mantle has the same physical structure as the original fabric from which it was made, whether it be cotton or any other fiber. It is obvious, then, that the strength and other physical properties of the mantle depend very largely on the nature of the original thread. For perhaps a dozen years after the discovery of the incandescent mantle all mantles were made from cotton. In those days it was a miracle enough to make any kind of a mantle. The industry was absolutely new and was beset with numerous difficulties, both chemical and physical, and one of the earliest difficulties was the finding of a suitable fabric. Ramie was first introduced in mantle-making by Buhlmann in 1898. It has certain marked advantages over cotton, particularly in maintaining its candle-power, and to this day many mantles are still made from ramie. It was found by Knöfler in the early nineties that artificial silk (nitro-cellulose) was better than cotton for the manufacture of mantles, because the life of the mantle was more than doubled. It would be out of the question to use a material as inflammable as



The Jablochkoff "candle." Edison's first lamp. Brush's first arc lamp.

The Jablochkoff "candle" gave less light than many of the modern incandescents do. It embodied a "filament" at the top, the fusion of which started an arc. Edison's first lamp was the outcome of the most indefatigable experimenting in the history of modern invention. Brush exhibited his first arc lamp of the wonderfully simple and successful ring-clutch type in 1877.

**Three interesting steps in the development of electric lighting.**

nitro-cellulose for the manufacture of fabrics, without rendering it safe. Hence, the thread is denitrated. In other words, we start with cotton, change it to nitro-cotton, which we dissolve and form into threads, and then take out the "nitro" part, leaving the original cotton, but with an entirely different physical structure. Instead of the short, hollow, opaque fibers of the original cotton, we now have solid lustrous filaments of unlimited lengths. Changing the cotton to nitro-cotton is simply a trick to get it in solution. The remarkable nature of this material is realized when we consider that a thread weighing one pound will reach twenty miles. This thread in turn is composed of twenty strands, and if these could be separated and placed end to end, their total length would be 400 miles. Ten pounds would reach from Maine to California.

Simultaneously with Knöfler, de Lery (1897) and Plaissetty (1900) patented processes for mixing the thorium and cerium nitrates with a solution of nitro-cotton in ether and alcohol and squirting this solution through fine orifices. None of these schemes, however, turned out to be a commercial success. Plaissetty seems to have been the only one to persevere. Finally, he hit upon what seems the very obvious idea of making a knitted fabric of artificial fiber and saturating it in the lighting fluid directly. As nitro-cellulose is absolutely solid and rod-like in structure, it absorbs 50 per cent more than the sponge-like cotton and ramie, because it is colloidal in nature. To harden the mantle thus made Plaissetty used ammonia. He took out patents in Germany in 1902 and in this country in 1904. His process was a commercial success.

Since 1904 vast improvements have been made in the manufacture of mantles from artificial fiber. Nitro-cellulose fibers are much better than natural fibers, because they are absolutely uniform, because they are free from indissoluble impurities, because they can be made absolutely continuous, and because they are strong. An artificial fiber mantle will support a weight of one ounce suspended from its loop without breaking. This is a remarkable tensile strength for a product which, after all, is composed of nothing but ash. Cotton falls off in candle-power during the first 100 or 200 hours, and after 100 hours sustains a loss of about 25 per cent. Ramie depreciates less rapidly, but unlike cotton, the color of the light changes to a whiter shade. Artificial fiber mantles actually increase in candle-power during the first 100 or 200 hours, and there is no change of color in the light even after 1,000 hours of burning. Unlike natural fibers, artificial fibers do not shrink, nor do they deteriorate in strength nearly so rapidly as cotton or ramie mantles. Hence, the artificial fiber mantle may be said to mark a distinct advance in the art of mantle-making, perhaps the greatest since the introduction of the thorium-cerium mantle itself.

In the last twenty years high-pressure systems of incandescent gas lighting have been developed after much experimenting and study, the object, of course, being to obtain more light from a given amount of gas. Pumps are required to supply the gas under pressure, a floating bell being necessary to eliminate the fluctuations caused by the strokes of the pump piston. One of the principal systems of this type was invented by Sugg and is much used in Europe in cities where gas is on a competitive basis with the electric arc. Other systems have been devised by Lucas, Selas, and Keith.

To avoid the use of pressure apparatus, what are known as self-intensifying systems have also been invented. In these the lamp itself contains its own apparatus for supplying an increased quantity of air and gas. One of the most indefatigable inventors in this field is Lucas, who after much experimenting designed a chimney of such form that a very powerful draft is produced which acts on the gas flame and air, with the result that a very brilliant light is obtained. Other inventors depend on little pumps attached to the lamp to obtain their forced feed. Thus, in the Scott-Snell system the lamp's own heat drives a plunger, which forces gas to the burner under pressure.

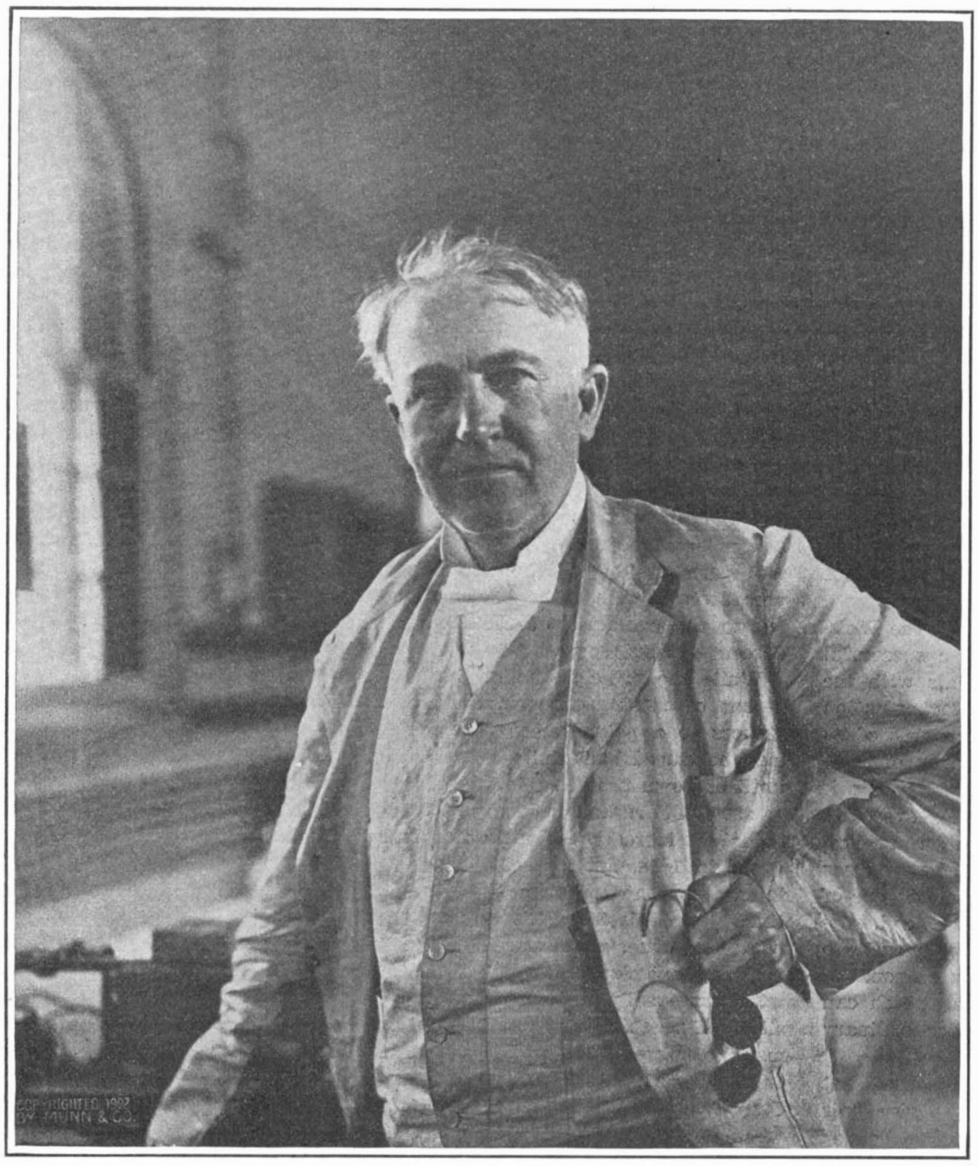
Clammond, we have said, invented an inverted gas mantle during the course of his investigations. He recognized the fact that a vertical burner throws its light above the horizontal, whereas it is needed below, and that objectionable shadows are cast by the mantle supports and lamp parts. It was easier with his type of mantle to invert it than with the Welsbach. Clammond used an inverted blowpipe above his mantle and forced the air and gas down. To convert the ordinary Bunsen burner into a blowpipe simply blackens the mantle and is otherwise objectionable. What was needed was evidently some form of Bunsen burner which could be placed over a mantle and still operate under the usual pressure. H. A. Kent dodged the problem by inventing in 1897 a siphon-like Bunsen burner with the inlets for gas and air below the burner head so that there was no tendency for carbon deposition.

Otto Mannesmann, Bernt, and Cervenka discovered independently in 1903 that in the inverted incandescent gas lamp it was necessary to feed the mantle with a stream of mixture of smaller cross-section than that of the mantle itself and the importance of conducting the secondary air (air of combustion) toward the descending gas-air mixture. Not until this discovery was made could the inverted incandescent gas lamp be considered really practical.

**The Evolution of Arc and Incandescent Lighting.**

The arc lamp and the incandescent lamp bore many more points in common in the early days of electric lighting than they do now. "Early days" should be construed electrically, of course—say the seventies and eighties. For example, the first arc lamp to be extensively commercialized was the "candle" of Jablochkoff (1876), which gave less light than many of the modern incandescents do, and embodied a "filament" at the top, the fusion of which started the arc. On the other hand, among the earliest incandescent lamps were the so-called "incandescence-arc" lamps, based on the principle of an arc playing between two incandescent wires in a partially evacuated bulb.

Then, too, the "active material"—to borrow a battery term—of both families of lamps was basically the same, being carbon both for lamp filaments and arc electrodes for many years; but later invention and development have caused the two families to grow apart, introducing filaments of osmium, tantalum and tungsten, and arc electrodes of metal or of carbon impregnated with various salts. However, arc and incandescent lamps have for a long time been developing contemporaneously, side by side as it were, so that in looking back over their history we need not draw too sharp a line of demarkation between them.



To my friend Munn Thomas A. Edison Orange Jany 10 1903.

Emil Rathenau, founder of the great *Allgemeine Elektricitäts Gesellschaft,* once told how he went to Paris in 1881, and at the electrical exhibition there saw the Edison exhibit. "The Edison system of lighting was beautifully conceived down to the very details and as thoroughly worked out as if it had been tested for decades in various towns. Neither sockets, switches, fuses, lampholders, nor any of the other accessories necessary to complete the installation were wanting; and the generating of the current, the regulation, the wiring with distributing boxes, house connections, meters, etc., all showed signs of astonishing skill and incomparable genius."

In our historical review it is not necessary to follow the precedent of Irving, who starts his Knickerbocker History of New York with the creation of the world. Save for a passing reference to Benjamin Franklin's kite-flying experiment (1752), which may be regarded as the connecting link between electric light in nature and electric light as produced by man, we may start with Sir Humphry Davy, who in 1801 first observed and studied the phenomenon of the electric arc. At this time there was not a single central lighting station—either gas or electric—in the world; even matches were undiscovered. For his electrodes, Davy used rods of wood charcoal, heated and plunged into mercury to make them better conductors. The arc light was not publicly exhibited until 1809, when, the dynamo being unknown, Davy's mammoth battery of 2,000 primary cells at the Royal Institution, London, served as a cumbersome source of current.

We now pass to the fourth decade of the nineteenth century—a decade the discoveries and inventions of which were destined to advance electric lighting tremendously. The most important of these discoveries, without doubt, was the principle of electromagnetic induction, announced by Michael Faraday in 1831, while Director of the Royal Institution. Details of the experiments that Faraday made in arriving at this grand underlying principle on which electric generators depend are preserved in his laboratory note-books, and may be read in the published accounts of his life. The principle was not to find its broad commercial application, however, until several decades later. The year after Faraday's epochal observation was made, Hippolyte Pixii constructed a "dynamo," one of the first on record, consisting of a stationary electromagnet in which currents were induced by the rotation of a permanent horseshoe magnet.

It is undeniable that much more honor is generally due to the man who actually accomplishes a task than to him who first suggests the possibility of its accomplishment; nevertheless a great amount of credit rightly belongs to the theorist who has the insight or originality to suggest a certain line of activity. Thus, the carbon-filament incandescent lamp may be said, without detracting a whit from the labors of those who invented it, to have been born in the brain of Prof. Jobard of Brussels, who in 1838 suggested that a small piece of carbon, if incandesced *in vacuo* by electricity, might be employed as a lamp. He transmitted this idea to his pupil, De Changy, who did considerable experimenting without, however, producing a commercially successful lamp.

Coming to the fifth decade, we find commercial arc lighting dimly foreshadowed in 1844, when Foucault, experimenting with gas-retort carbon and using this in connection with a galvanic battery, produced such a steady and continuous light that he was able to use it for photographic purposes. Foucault's arc was the forerunner of a great many types of arc lamps that were to make their appearance from this time on until about 1860, none of which, however, combined the commercial requirements of simplicity and reliability to a sufficient degree to bring them into widespread use, especially at a time when the dynamo was idling away a protracted infancy in its cradle, the laboratory.

Among the freak types of arc lamp that passed into history during this early development period may be mentioned the Wright arc of 1845—the first arc lamp patented in England. This curious machine consisted of five circular carbon disks in series, of which two were movable by means of hand-screws serving to draw out the four arcs. No less awesome was the American arc-lamp of Wallace, in which the arc flame played back and forth over a linear space of about a foot, along a narrow gap between the opposed edges of two immense rectangular carbon slabs. One of these Wallace arcs is preserved in the National Museum at Washington; they were used commercially, in conjunction with the Wallace-Farmer dynamo, for street lamps in Baltimore

*(Concluded on page 575.)*

# Some Personal Recollections

## An Autobiographical Sketch

By Nikola Tesla

I AM glad to be accorded this opportunity for two reasons. In the first place I have long since desired to express my great appreciation of the SCIENTIFIC AMERICAN and to acknowledge my indebtedness for the timely and useful information which its columns are pouring out in a steady stream. It is a publication remarkable for the high quality of special articles as well as for the accurate review of technical advances. The knowledge it conveys is always reliable and rendered still more valuable through the scrupulous observance of literary courtesy in the quotation of the sources. The services it has rendered in helping invention and spreading enlightenment are inestimable. The SCIENTIFIC AMERICAN is a periodical ably and conscientiously conducted, measured and dignified in tone to the point of serving as a model, and in these features, as much as in the wealth and excellence of its contributions, it reflects great credit, not only on its staff and publishers, but on the whole country. This is not an idle compliment, but a genuine and well-deserved tribute to which I add my best wishes for continued success on this memorable occasion.

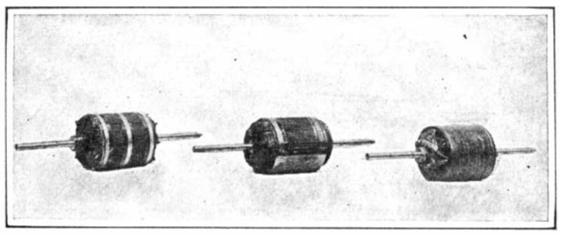
The second reason is one that concerns me personally. Many erroneous statements have appeared in print relative to my discovery of the rotating magnetic field and invention of the induction motor which I was compelled to pass in silence. Great interests have waged a long and bitter contest for my patent rights; commercial animosities and professional jealousies were aroused, and I was made to suffer in more than one way. But despite of all pressure and efforts of ingenious lawyers and experts, the rulings of the courts were in support of my claims for priority in every instance without exception. The battles have been fought and forgotten, the thirty or forty patents granted to me on the alternating system have expired, I have been released of burdensome obligations and am free to speak.

Every experience which I have lived through bearing on that early discovery is vividly present in my memory. I see the faces of the persons, the scenes and objects of my attention, with a sharpness and distinction and in a fullness of light which is astonishing, and is a measure of the intensity and depth of the original impressions. I have always been fortunate in ideas, but no other invention, however great, could be as dear to me as that first one. This will be understood if I dwell briefly on the circumstances surrounding it and some of the phases and incidents of my young life.

From my childhood I had been intended for the clergy. This prospect hung like a dark cloud on my mind. After passing eleven years at a public school and a higher institution, I obtained my certificate of maturity and found myself at the critical point of my career. Should I disobey my father, ignore the fondest wishes of my mother, or should I resign myself to fate? The thought oppressed me, and I looked to the future with dread.

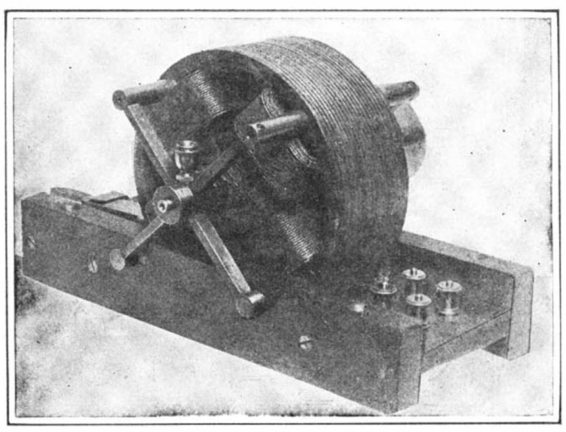
Just at that time a terrible epidemic of cholera broke out in my native land. People knew nothing of the character of the disease and the means for sanitation were of the poorest kind. They burned huge piles of odorous shrubbery to purify the air, but drank freely of the infected water and died in crowds like sheep. Contrary to peremptory orders from my father I rushed home and was stricken down. Nine months in bed with scarcely the ability to move seemed to exhaust all my vitality, and I was given up by the physicians. It was an agonizing experience, not so much because of physical suffering as on account of my intense desire to live. On the occasion of one of the fainting spells my father cheered me by a promise to let me study engineering; but it would have remained unfulfilled had it not been for a marvelous cure brought about by an old lady. There was no force of suggestion or mysterious influence about it. Such means would have had no effect whatever on me, for I was a firm believer in natural laws. The remedy was purely medicinal, heroic if not desperate; but it worked and in one year of mountain climbing and forest life I was fit for the most arduous bodily exertion. My father kept his word, and in 1877 I entered the Joanneum in Gratz, Styria, one of the oldest technical institutions of Europe. I proposed to show results which would repay my parents for their bitter disappointment due to my change of vocation. It was not a passing determination of a light-hearted youth; it was iron resolve. As some young reader of the SCIENTIFIC AMERICAN might draw profit from my example I will explain.

When I was a boy of seven or eight I read a novel entitled "Abafi"—The Son of Aba—a Servian translation from the Hungarian of Josika, a writer of renown. The lessons it teaches are much like those of "Ben-Hur," and in this respect it might be viewed as anticipatory of the work of Wallace. The possibilities of will-power and self-control appealed tremendously to my vivid imagination, and I began to discipline myself. Had I a sweet cake or a juicy apple which I was dying to eat I would give it to another boy and go through the tortures of Tantalus, pained but satisfied. Had I some difficult task before me which was exhausting I would



**Three rotors used with the early Tesla induction motor shown below.**

attack it again and again until it was done. So I practised day by day from morning till night. At first it called for a vigorous mental effort directed against disposition and desire, but as years went by the conflict lessened and finally my will and wish became identical. They are so to-day, and in this lies the secret of whatever success I have achieved. These experiences are as intimately linked with my discovery of the rotating magnetic field as if they formed an essential part of it;

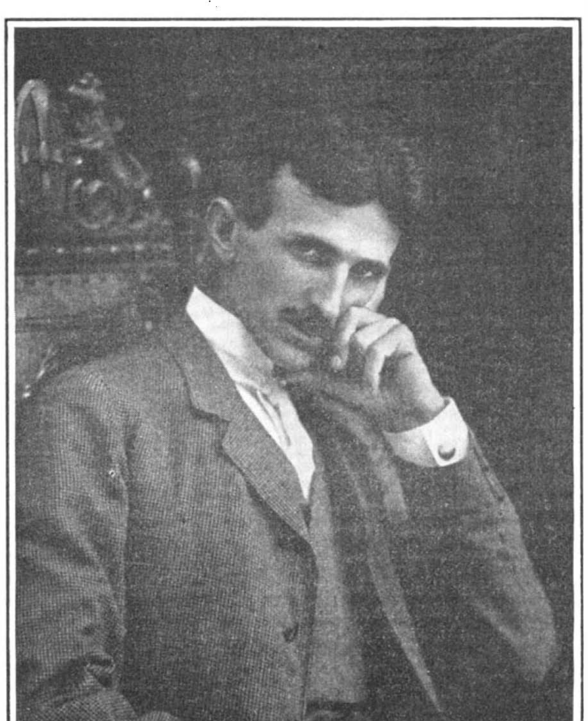


**One of the earliest of Tesla's induction motors.**

Although it weighed only a little over 20 pounds, it developed ¼ horse-power at a speed of 1,800 revolutions, a performance considered remarkable at the time.

but for them I would never have invented the induction motor.

In the first year of my studies at the Joanneum I rose regularly at three o'clock in the morning and worked till eleven at night; no Sundays or holidays excepted. My success was unusual and excited the interest of the professors. Among these was Dr. Allé, who lectured on differential equations and other branches of higher mathematics and whose addresses were unforgetable intellectual treats, and Prof. Poeschl, who held the chair of Physics, theoretical and experimental. These men I always remember with a sense of gratitude. Prof. Poeschl was peculiar; it was said of him that he wore the same coat for twenty years. But what he lacked in personal magnetism he made up in the perfection of his exposition. I never saw him miss a word or gesture, and his demonstrations and experiments always went off with clocklike precision. Some time in the winter of 1878 a new apparatus was installed in the lecture room. It was a dynamo with a laminated permanent magnet and a Gramme armature. Prof. Poeschel had wound some wire around the field to show the principle of self-excitation, and provided a battery for running the machine as a motor. As he was illustrating this latter feature there was lively sparking at the commutator and brushes, and I ventured to remark that these devices might be eliminated. He said that it was quite impossible and likened my proposal to a perpetual motion scheme, which amused my fellow students and embarrassed me greatly. For a time I hesitated, impressed by his authority, but my conviction grew stronger and I decided to work out the solution. At that time my resolve meant more to me than the most solemn vow.



Nikola Tesla.

I undertook the task with all the fire and boundless confidence of youth. To my mind it was simply a test of will-power. I knew nothing of the technical difficulties. All my remaining term in Gratz was passed in intense but fruitless effort, and I almost convinced myself that the problem was unsolvable. Indeed, I thought, was it possible to transform the steady pull of gravitation into a whirling force? The answer was an emphatic no. And was this not also true of magnetic attraction? The two propositions appeared very much the same.

In 1880 I went to Prague, Bohemia, carrying out my father's wish to complete my school education at a university. The atmosphere of that old and interesting city was favorable to invention. Hungry artists were plentiful and intelligent company could be found everywhere. Here I made the first distinct step in advance, by detaching the commutators from the machines and placing them on distant arbors. Every day I imagined arrangements on this plan without result, but feeling that I was nearing the solution. In the following year there was a sudden change in my views of life. I realized that my parents were making too great sacrifices for me and resolved to relieve them of the burden. The American telephone wave had reached the European continent, and the system was to be installed in Budapest. It appeared an ideal opportunity, and I took the train for that city. By an irony of fate my first employment was as a draughtsman. I hated drawing; it was for me the very worst of annoyances. Fortunately it was not long before I secured the position I sought, that of chief electrician to the telephone company. My duties brought me in contact with a number of young men in whom I became interested. One of these was Mr. Szigety, who was a remarkable specimen of humanity. A big head with an awful lump on one side and a sallow complexion made him distinctly ugly, but from the neck down his body might have served for a statue of Apollo. His strength was phenomenal. At that time I had exhausted myself through hard work and incessant thinking. He impressed me with the necessity of systematic physical development, and I accepted his offer to train me in athletics. We exercised every day and I gained rapidly in strength. My mind also seemed to grow more vigorous and as my thoughts turned to the subject which absorbed me I was surprised at my confidence of success. On one occasion, ever present in my recollection, we were enjoying ourselves in the Varos-liget or City Park. I was reciting poetry, of which I was passionately fond. At that age I knew entire books by heart and could read them from memory word by word. One of these was Faust. It was late in the afternoon, the sun was setting, and I was reminded of the passage:

"Sie rückt und weicht, der Tag ist überlebt,
Dort eilt sie hin und fördert neues Leben,
Oh, dass kein Flügel mich vom Boden hebt
Jhr nach und immer nach zu streben!

* * * * * * * *

Ach, zu des Geistes Flügeln wird so leicht
Kein körperlicher Flügel sich gesellen!"

As I spoke the last words, plunged in thought and marveling at the power of the poet, the idea came like

(Concluded on page 576.)

# Machines With Which Machines Are Made

## A Brief History of the Development of Metal-Working Power-Driven Tools

HOW nearly the SCIENTIFIC AMERICAN dates back to the very beginning of the machine tool industry in this country will be realized when it is known that the first planing machine was introduced into the country in 1830. Eight years later there were only four such machines in the United States, and when in 1845 the SCIENTIFIC AMERICAN began its weekly record of progress in the mechanical arts, there was no hint of the tremendous development of the American machine tool industry that was soon to follow.

In the very earliest days it was the textile machinery that provided the most work for machine tools. Then the Mexican war produced great activity in the arms and ammunition factories, which resulted in the building of many machine tools and the development of a number of important improvements. The civil war and the sewing machine industry furnished other chapters in the progress of machine tools, and by 1876 they had developed to such an extent as to form the most remarkable feature of the Centennial Exposition in Philadelphia. A glowing tribute to the ingenuity and resourcefulness of the American mechanical engineer was paid by Dr. John Anderson, who made a report to the British Parliament on machines and tools for working metal, wood and stone at the Exposition. He said: "The display of machine tools made by the United States was so vast that only the more salient points can be noted in a brief report. Americans as a rule are not copiers; the inventing of clever devices and tools for saving labor seems to be their natural forte, and, worthy of the old stock, they are probably quickened by the peculiarly favorable circumstances under which they live. It was the display made in this section which most conspicuously brought out the enormous strength of America as a producing power."

The textile industries continued to furnish the chief stimulus for the development of machine tools until the close of the century, when suddenly the automobile industry sprang into existence. At the same time the new high-speed tool steels were introduced. At the Paris Exposition in 1900 the public was astonished to see a machine taking such heavy cuts and at such a high speed that the shavings were at a blue heat, while the tool itself showed red hot even in daylight. Messrs. Taylor and White, two Americans experimenting with manganese and tungsten steel, had found a method of treating the alloys at high temperatures, which increased their efficiency greatly. The new steels increased the cutting speed of tools about 300 per cent. Immediately this had a wonderful influence upon the industry. Machines had to be redesigned to stand the enormous strains of taking such great cuts. At the same time the rapidly growing automobile industry furnished no end of capital for the development of all kinds of powerful and automatic machinery. The electric motor was introduced in the shop about this time, providing for individual drive, and hence a higher efficiency of operation.

Such in brief are the more important epochs in the development of machine tools.

Going back seventy years, we find that the lathe, the planer, the shaper, the slotting machine, the boring mill, and the drill had already been originated in England and introduced into this country. America's most valuable contributions to the machine tool industry were the turret lathe, which developed into the screw machine and the almost human automatic, and the milling machine, from which have grown certain types of gear cutting machines.

Some time between 1845 and 1853 Stephen Fitch, pondering upon a method of producing screws more cheaply, hit upon the idea of furnishing his lathe with a number of tools set in a holder which could be revolved to bring them successively to the working position. This was the first revolving turret lathe, but the turret had to be turned by hand. In 1855 a machine was produced by the Jones & Lamson Machine Company, which had mechanism for turning the turret automatically, so that after a cut was finished with one tool the turret revolved a step and without any attention on the part of the operator would present the next tool to the work, without destroying the adjustment of the first, which would remain ready for the next piece when its turn came.

The next important advance in the turret lathe was made in 1889 by James Hartness, and patents on it were granted in 1891, and again in 1904. This was the introduction of a flat style of turret, which carries the tool holders upon the top instead of about its periphery.

These tool holders are designed to take simple turning and boring tools somewhat after the manner of the tool post of an engine lathe, and thus reduce the amount of tool-making required and adapt the machine to the production of parts in small lots. In addition to this, long pieces may be used in the machine, since, there being nothing in the way to prevent, the turret may pass under the piece without interfering. Another feature of this lathe is the mounting of the headstock upon a cross-slide, which performs the function of the cross-slide of an engine lathe and permits facing, necking, and internal undercuttings to be done. The accompanying photograph shows the flat turret with cross-sliding headstock.

The machine is driven by a constant speed pulley, while in the headstock is a system of gearing which may be changed by means of the hand levers shown in the foreground of the photograph to provide nine different speeds.

In 1894 Conrad M. Conradson invented a lathe having a hole lengthwise through its spindle to adapt it for work "from the bar." The bar is of rough stock passed through the spindle and pushed forward and then gripped in the chuck after each piece has been finished and cut off. A tool slide having a crosswise movement only, though adjustable lengthwise of the lathe, is provided. This slide has two tool posts, of which the one in the rear, fitted with an inverted tool, may be used for cutting a recess, rounding a corner, etc., as the case may be.

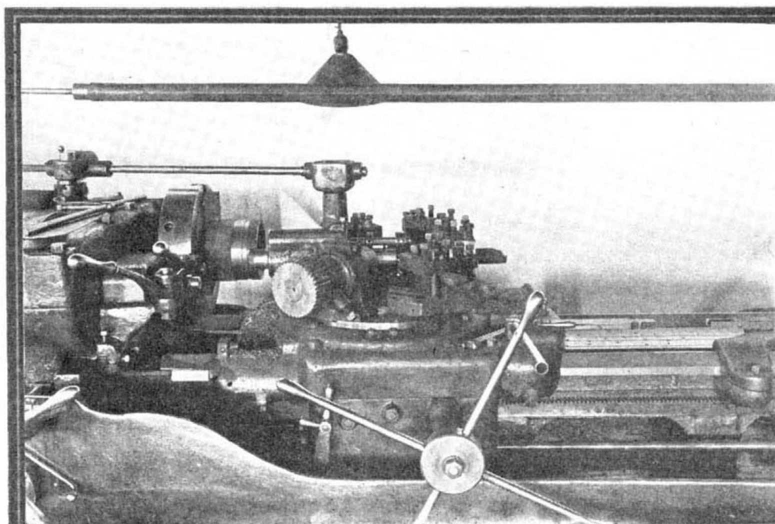
A vertical turret lathe appeared in 1901. This was invented by E. P. Bullard. In this lathe a supplementary cross-slide turret capable of carrying four tools is provided. Observation stops are used. Large micrometer dials carrying adjustable indexes are attached to the feed screw shafts, the sizes of the work being determined by the matching of these indexes against stationary indexes. The sizes of the work dealt with make impractical the use of the usual special tools set for outer diameters. Accordingly, the tools used are like those used in engine lathes, the outer diameters as well as the lengths of the pieces made being determined by the observation stops.

Up to 1908 the utility of the vertical turret lathes was limited in that the tool of neither crosshead nor slidehead could be fed at an oblique angle to the table, a requirement demanded by a large class of work. The cutting capacity of the side tool was also limited in that the sidehead in its upward travel struck the cross-guide ways before the tool reached a height from the table corresponding to that of the underside of the guideways which determine the range of the vertical cut. E. P. Bullard in 1908 invented a machine eliminating these restrictions and limitations. In this machine the two heads are so designed that the cutting tool of each has a transverse and longitudinal movement the full axial and radial swing of the rotary table and are so combined that the respective tools may be brought into close contact with each other anywhere within their sphere of operation, and in that position fed conjointly crosswise or lengthwise of the axis of rotation of the work. The two tools, for example, may be conjointly used on a crosswise or lengthwise roughing cut. This machine by joint use of the tools does twice as much work as could formerly be done by either tool alone.

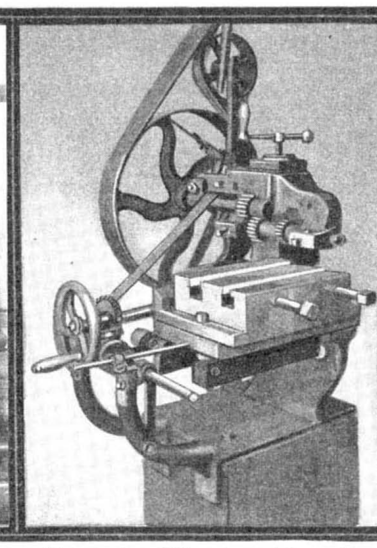
The development of the turret lathe is still proceeding. Less than two years ago two important improvements were disclosed. J. C. Potter in his patent granted September 9th, 1913, devised an automatic turret lathe capable of operating at a higher speed than known before. In this machine the mechanism by which the turret slide is moved when the cam is not acting thereon can be made to move the turret slide at a much higher speed than it can be moved by the cam, and the movement of the cam drum can be timed so that the proper cam is in readiness to begin its work the instant that the other slide-moving mechanism finishes its portion of the movement of the turret slide.

W. L. Miller was granted a patent December 16th, 1913, for an automatic turret lathe in which are two intermittently moving drums, each of which having applied thereto, in various positions thereon, cam blocks which in turn, as the drums are rotated, engage the lower ends of certain levers, the upper ends of which are connected to the several mechanisms through which changes of speed and direction of movement of the operating parts that engage the work are effected. The shaft on which these drums are mounted is connected with the pulley or main driving shaft of the machine through driving connections which are normally idle, but are adapted to be rendered active by certain trip devices automatically thrown into operation to move or index the drum around one or more steps by trips or projections carried by the several moving parts that are controlled as to their speed and direction of movement by the intermittently moving cam drums.

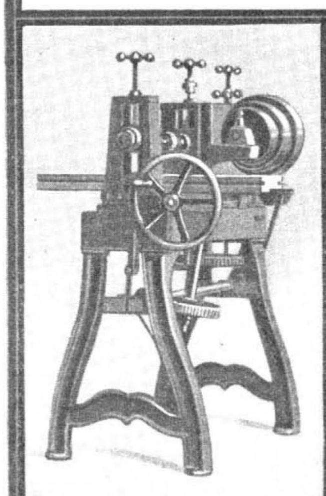
By this mechanism, the operator, knowing in advance the various opera-



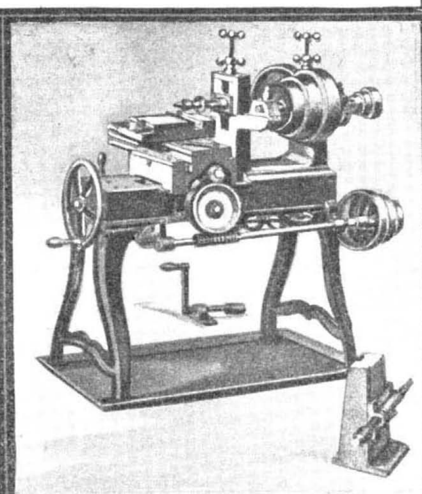
Flat turret lathe with cross-sliding head.



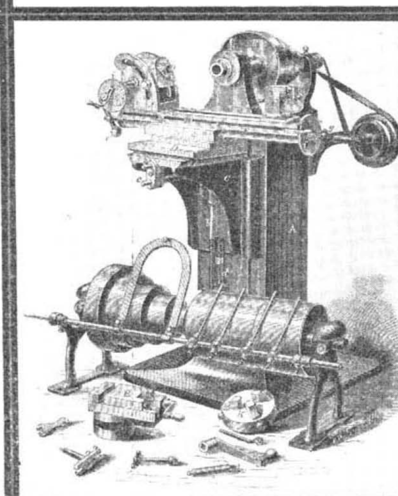
Typical milling machine of 1845.



Howe's milling machine of 1853.



Pratt's milling machine, built in 1854.



Brown's universal milling machine (1861).

tions to be performed upon a given piece of work, the tools to be used, the proper feeds to be given each tool, and the proper spindle speeds, sets the cams on the drums accordingly to produce automatically the predetermined movements and speeds; places the work in the chuck, and applies the power to the main shaft pulley. The machine then automatically performs these several operations in proper order or succession, and automatically stops when they are completed, leaving it to the operator only to remove the finished work and insert in the chuck a new piece of work. The utility of this improvement is obvious.

It was Eli Whitney, of the cotton gin fame, who in 1815 invented the first milling machine, and built a machine of this type at about that time in New Haven, Conn. When the SCIENTIFIC AMERICAN first came into being the milling machine had been improved to the extent of having vertical adjustment for the cutter spindle. A machine of this type is shown in one of the accompanying photographs. It was built by Gay Silver & Co. of North Chelmsford, Mass. In 1853 Frederick W. Howe, then in the employ of Robbins & Lawrence of Windsor, Vt., developed a milling machine which is the prototype of what has since been known as the Lincoln miller. The Lincoln miller was designed by F. A. Pratt of the Pratt & Whitney Company in 1854.

In 1861 Joseph R. Brown of the Brown & Sharpe Manufacturing Company developed the universal milling machine, which contained the vital principles of the universal milling machine of to-day. This machine was designed to cut spiral grooves in twist drills which had been worked out by hand prior to that date. The accompanying cut of the machine is reproduced from the SCIENTIFIC AMERICAN of December 27th, 1862. Many of these machines were built and sold during the Civil

the starting and stopping of the machine are normally controlled by the operator.

The development of cylindrical grinding began about fifty years ago. Such grinding was done in a crude way as early as 1860. Owing to the necessity of finishing needle and foot bars for sewing machines, the Brown & Sharpe Company built a grinding machine which was put on the market in 1864 and 1865. This consisted of a 14-inch lathe with a wheel stand mounted upon the carriage. It was provided with a reversing speed mechanism. Ten years later came the universal grinder invented by Joseph R. Brown, which was exhibited at the Centennial Exposition.

During the early fifties hand-operated gear-cutting machines were in use, and in 1855 Mr. Joseph R. Brown designed and built a precision gear-cutting machine adapted not only for cutting gears, but for index drilling and circular graduating.

As is well known, there are three basic systems of gear cutting: the formed tool system; the generating system, of which the hobbing system is a development, and the templet system.

William Sellers & Co. in 1866 were the first to perform the functions of the tool system automatically, some of the machines then made being still in use in the Sellers shops. The first commercial automatic machine, however, was produced by Brown & Sharpe in 1877. In the latter machine the action is entirely automatic, the feed and return of cutter and the indexing of the blank from tooth to tooth requiring no attention on the part of the operator, who has but to remove the completed gears and supply their place with blanks.

The generating system of gear cutting was invented by Hugo Bilgram in 1884. The purpose of this machine was to produce bevel gears, for which at that time no satisfactory method of production was available.

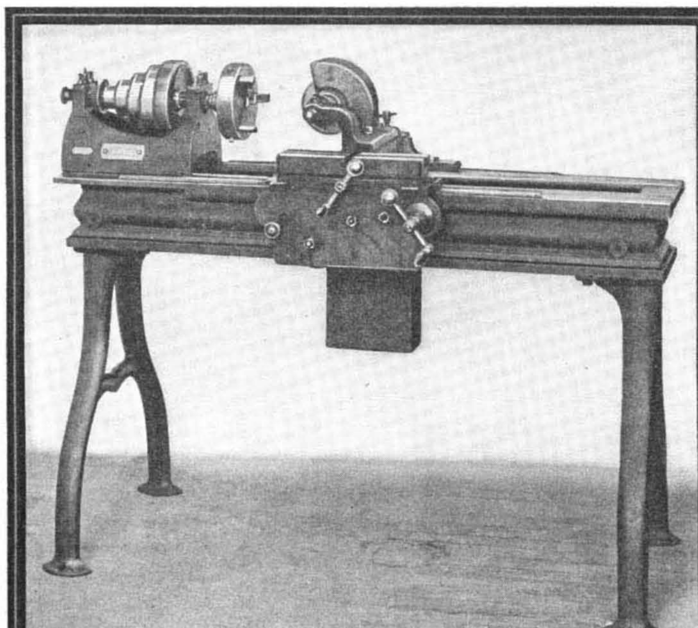
E. R. Fellows is the leading representative of the generating system in his patents of 1901, 1907, 1908, 1911, and 1912. In the Fellows machines the cutter and blank revolve slowly as the cutter reciprocates vertically. It also is generated from an ideal or imaginary rack tooth represented by the side of an abrasive grinding wheel, the final generation being done after the cutter is hardened. These machines are of the highest degree of precision.

The hobbing process of gear cutting is a modification of the generating system and was originally done in Germany. The hob is represented by a worm, which cuts the gear. In action the hob is adjusted at an angle such that the tangent to the helix is parallel with the teeth to be cut. The feed is double, that is, the gear blank revolves, and as it does so the hob is fed slowly across it. The cut is continuous, the gear being completed as the hob leaves its farther edge. By suitable adjustments helical gears may be cut with the same ease as spur gears.

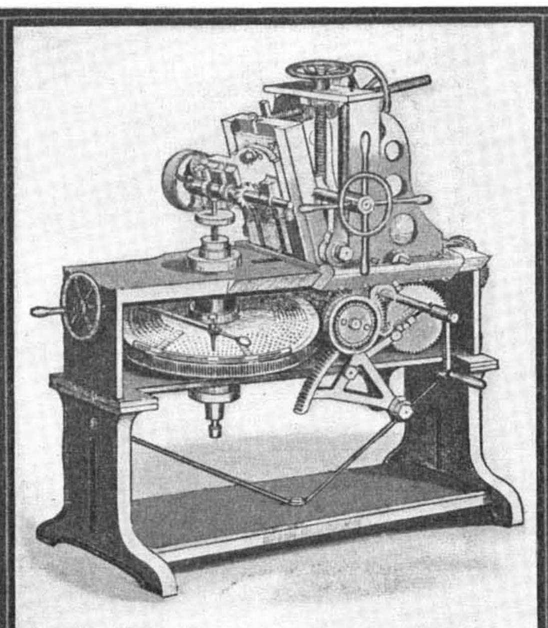
The templet system of gear cutting is most commonly used for large cut mill gears. Obviously, for such gears the cost of special cutters is prohibitive while a templet costs but little.

By a suitable feeding mechanism the tool is guided by rollers which ride on the templets. But one of the templets is in position at a time in actual use, thus avoiding interference with each other.

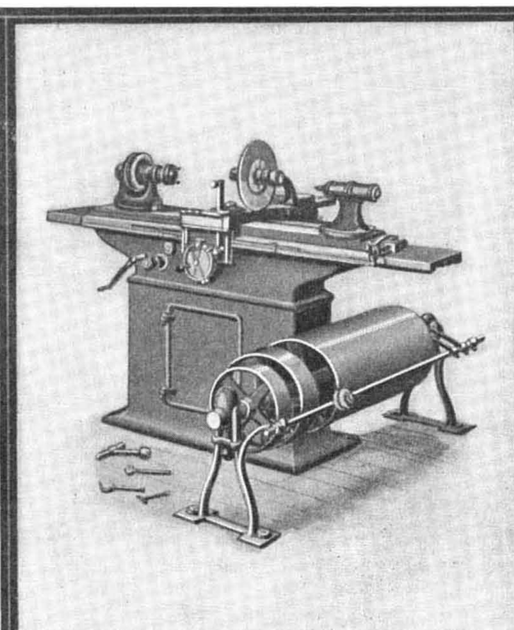
The application of the templet system to cutting bevel gears is done in the Gleason shops. The arm which carries the planing tool moves about the cone center of the gear to be cut, and its movement is guided by the templet on which a roller attached to the arm rides. The templet has the outline of the desired tooth profile suitably enlarged to provide for its increased distance from the cone center.



Photograph of cylindrical grinder put on the market in 1865. Some of the mechanism is missing.



Joseph R. Brown's machine for gear cutting, index drilling and circular graduating (1855).



Universal grinding machine of 1876, exhibited at the Centennial Exposition.

War, and following the Paris Exposition of 1867, where one was exhibited, a start was made in selling the American milling machine abroad. This was one of the factors leading to the establishing of an extensive business in American machine tools in foreign countries.

The most recent development in this type of machine is found in the semi-automatic machine of the Cincinnati Milling Machine Company. Two milling heads for simultaneous operations on both sides of the work are used, although single-head machines are also made by this company. The feature of these machines is the provision of an automatic quick return to the work table, and also an automatic increase in the forward movement for the numerous cases in which the surface to be machined is not continuous. A double set of dogs for controlling the feed mechanism is attached to the side of the work table. The work being properly chucked and one of the levers tripped, the table goes quickly forward at a rate of 100 inches per minute until the first surface to be machined reaches the cutter, when the motion automatically slows down to whatever feed has been selected, and this continues until one of the faces is milled. As soon as the cutter has passed this first face, the table automatically speeds up again to one hundred inches per minute, until the second face of the work reaches the cutter. Again the work proceeds at the speed selected, and, passing the second face, speeds up again, then slows down again when the third face is reached, feeds along the third face, and when this is completed, the table automatically returns at 100 inches per minute to the starting point.

Because of these movements the machine is semi-automatic, that is, the movements of the table are entirely automatic; but the chucking of the work and

In the first Bilgram machine the action was not fully automatic, but the later ones were. In these machines the straight-sided tool which represents one side of a rack tooth is mounted upon a ram driven precisely like a shaping machine ram. The gear blank is mounted below the tool upon a suitable arbor supported at its rear end by a conical segment which rolls upon a plane surface below it. The conical segment is a portion of the pitch surface of the gear to be cut, extended to the opposite nappe of the cone, while the plane surface is a portion of the pitch surface of the imaginary crown gear of which the cutting tool represents one side of a tooth.

The patents of J. E. Gleason in 1898, 1907, and 1910 disclosed many improvements on the Bilgram machine. In the Gleason machines the imaginary rack represented by two tools travels endwise with the feed, the gear blank turning upon its center, which does not change its position. The tools are mounted and reciprocate in guides on an arm which oscillates about the cone center of the gear blank cut, this oscillation being obtained by a horizontal yoke and vertical connecting rod. This yoke is secured to the main spindle and carries a segment gear, the pitch cone of this segment being identical with that of the gear blank being cut.

Mounted on the tool carrying arm is a second segment gear in mesh with the first. The second segment is a segment of a crown gear, its pitch plane being identical with that of the ideal crown gear tooth represented by the cutting tools. As the yoke oscillates it turns the gear blank with it, while the meshing of the segments compels the tool arm to oscillate and to carry the cutting tools past the blank in the same relation as a crown gear tooth in mesh with a tooth on the blank. The action of these machines is fully automatic.

Such in brief is the story of machine tools down to the present day, but their history is not yet finished. American mechanical engineers are renowned the world over, and they are as active as ever in producing improvements and in making machines that will work steadily without the slightest attention, bringing one tool after another into action and turning out most intricate pieces of work, as long as they are supplied with the stock to work upon.

## Some Early American Patents

IT is reported that the first American patent for a piano was issued to James S. McLean of New Jersey, May 27th, 1796; the first United States patent for washing machine was to Nathaniel Briggs of New Hampshire, March 28th, 1797; first United States patent for steam engine was to James Rumsey, August 26th, 1791; first United States patent for gas engine was to Samuel Brown of England, March 2nd, 1824; and that the first United States patent for air engines was to E. and J. Prentiss of Baltimore, June 22nd, 1824.

Richard M. Hoe's first United States patent for printing machine was granted May 20th, 1842, last patent April 27th, 1880.

John Ericsson issued his first United States patent February 1st, 1838, when he lived in Sweden; his second patent was issued November 5th, 1840, while he still resided in Sweden; a third patent issued in December, 1844, when he was living in New York; the last patent issued to him was on December 6th, 1887, while a later patent issued to his executors July 8th, 1890.

Thomas A. Edison's first patent issued June 1st, 1869, No. 90,646; many hundreds of patents have issued to him since that date, the Patent Office fees alone running up into thousands of dollars.

Alfred Ely Beach, Founder of Munn & Co.

# Seventy Years of the Scientific American

## How the Scientific American Was Founded and How It Grew from Very Small Beginnings; the Active Part Played by Its Editors in Stimulating Public Interest in Science and Invention

Orson Desaix Munn, Founder of Munn & Co.

TO picture adequately the part which the SCIENTIFIC AMERICAN has played for nearly seventy years would necessitate the writing of a complete history of modern science. So interwoven is the career of the greatest popular scientific paper ever published with the great discoveries and inventions that each issue, beginning with September 7th, 1845, may be regarded as a cross-section of the scientific knowledge of the day.

The SCIENTIFIC AMERICAN as we know it to-day is a monument to the untiring energy and enthusiasm of Mr. Orson D. Munn and Mr. Alfred E. Beach, who composed the original partnership of Munn & Co.

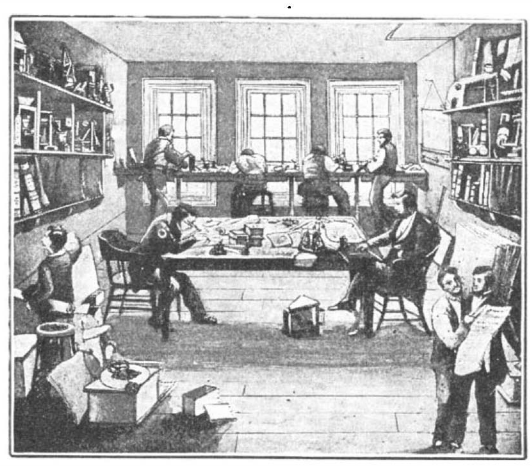
Mr. Beach had been brought up in the offices of the New York *Sun*, of which his father, Moses Yale Beach, was the proprietor. It was but natural that the first office of Munn & Co. should have been located in the old Sun Building, on the corner of Fulton and Nassau streets, in New York city.

The first issue, which bears the date September 7th, 1845, was about as large as a modern daily newspaper. There were only four pages. That first issue boldly declares that "The SCIENTIFIC AMERICAN is the advocate of industry and the journal of mechanical and other improvements." Apparently there was not much industry to advocate or many mechanical improvements to record; for the editor found space enough to publish poetry, dissertations on temperance, and brief articles on such curious topics as "The Utility of Tribulations,' "The Evil Influence of Fashion," "Street Beggars," "Oriental Servility," and "Church Benevolence."

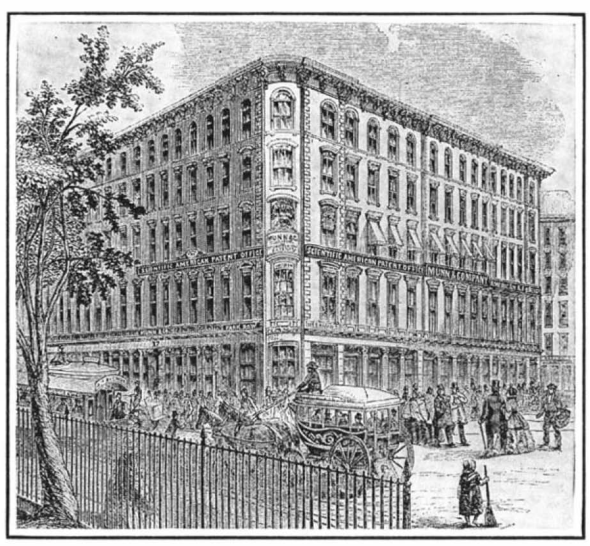
When the SCIENTIFIC AMERICAN was first published the great achievements of the century were Davy's discovery of the electric arc light and of electrolysis; Oersted's and Ampere's electro-dynamic discoveries; Daguerre's method of photographing; Henry's and Faraday's discoveries in induction; and Joule's determination of the mechanical equivalent of heat.

**Restraining the Advertiser.**

As interesting historically as the editorial pages are the advertising columns of the SCIENTIFIC AMERICAN. Among the first advertisements that appeared was one of Adams & Co., offering to transmit "valuable packages and parcels of every description" from Philadelphia to New York at the unprecedented rate of three days. The modern kodak advertisement finds its counterpart in advertisements of apparatus for making daguerreotypes. By 1849 the advertisements had increased so alarmingly that the publishers considered it their duty to apologize in the issue of May 5th, 1849, for printing the unpardonable number of two and one half columns of advertising. To restrain the advertiser as much as possible, there appeared for some years at the head of the advertising section of the SCIENTIFIC AMERICAN a notice (it was almost a warning) that read:



Patent Department of Munn & Co. in 1849. From a contemporary print.



The Scientific American offices at 37 Park Row, 1859-1882.

One square of eight lines, 50 cents for each insertion.
One square of 12 lines, 75 cents for each insertion.
One square of 16 lines, $1 for each insertion.
Advertisements should not exceed sixteen lines, and cuts cannot be inserted in connection with them at any price.

Time and the increasing importance of advertising in modern journalism changed that haughty attitude. "Display copy," as it is now called, was accepted in any amount in the late seventies.

It is curious the way in which firms, then small but now colossal, announced their readiness to serve the public. The Lamb Knitting Machine Company, the Otis Elevator Company, Jones & Laughlin, the American Bell Telephone Company, the Westinghouse Company, corporations now of international importance, stated the nature of their business with the formal politeness and ceremonious phraseology of a wedding invitation. Later, when the psychological effect of advertising was better understood, they become more direct, more personal in their appeal. One of the pioneers in that direction was George B. Eastman, who selected the SCIENTIFIC AMERICAN as the first medium in which to advertise the kodak.

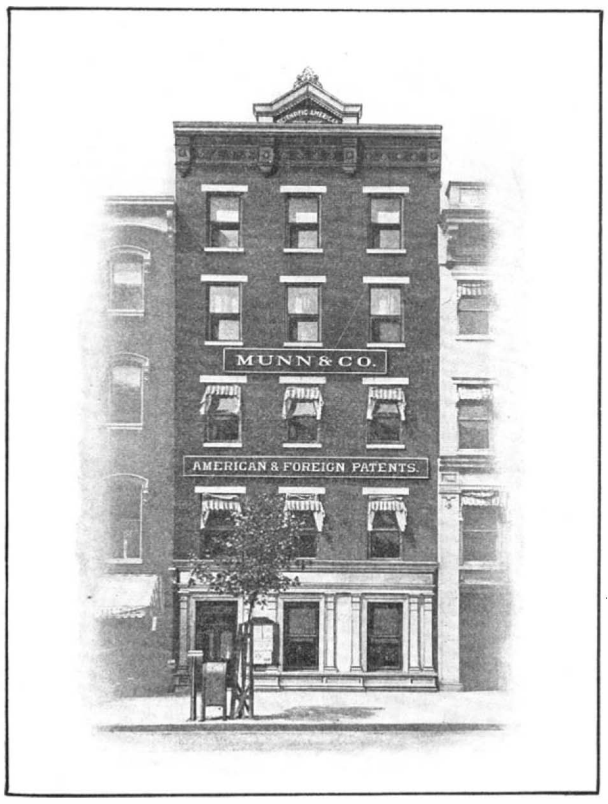
**How the Patent Department Was Created.**

Because it was the only scientific paper of its kind, the offices soon became a meeting place for inventors. Out of this intimate relation sprang the necessity of creating a special department for inventors, a department to give advice on the patenting of inventions and on patent law. From its very inception that department has proved the most successful patent agency ever established. Among its clients have been such distinguished men as Samuel F. B. Morse, inventor of the telegraph; Elias Howe and A. B. Wilson, famous for their sewing machine inventions; Capt. James B. Eads, the distinguished builder of the great Mississippi bridge; Capt. John Ericsson, designer of the "Monitor"; Dr. R. J. Gatling, inventor of the Gatling gun; Peter Cooper Hewitt, inventor of the mercury arc light; Cornelius Vanderbilt, Col. J. J. Astor, Dr. Leo Baekeland, the chemist; Henry Guy Carlton, the dramatist, and Thomas A. Edison.

Some of the inventions patented by these men and others have been noteworthy. Among them may be mentioned the mercury arc light, the centrifugal snow plow, the kodak, the Murray page-printing telegraph, the Edison telegraph improvements, the Livingston radiators, the Hartshorn shade roller, Emerson's Bromo-Seltzer.

United States Patent Office and Munn & Co.'s first office in Washington. (From an old print of 1859.)


Interior of Scientific American offices at 37 Park Row, 1859-1882. Here many famous inventors of the day came for advice.




**Scientific American Building, Washington.**

Is it any wonder that inventions which have proved the foundations of great industries were thus first brought to the notice of the publishers of the SCIENTIFIC AMERICAN, long before the general public, or even the Patent Office, ever heard of them?

**A. B. Wilson and the Sewing Machine.**

Thus, one day, A. B. Wilson, a journeyman cabinet maker, came from Pittsfield, Mass., to lay before the SCIENTIFIC AMERICAN the model of a sewing machine. He had been derided by his neighbors, all of whom regarded it as rather foolish to sew by machine. His invention proved to be a distinct improvement in the art, and its four-motion feed, eventually embodied in the Wheeler & Wilson sewing machine, made its inventor wealthy. The world first heard of it through the SCIENTIFIC AMERICAN of November 24th, 1849.

Thomas A. Edison, too, was a visitor in the early days of his brilliant career. In 1877, he came to the office and placed before the editors a small machine, about which he offered very few preliminary remarks. He turned a crank and, to the astonishment of everyone present, the machine said: "Good morning. How do you do? How do you like the talking box?" That was the first public audience to which the modern phonograph ever addressed itself. So, too, the SCIENTIFIC AMERICAN editors were among the first who ever saw the electric incandescent lamp, the kinetoscope, the Edison dynamo, and the score of famous inventions with which the name Edison is now identified.

**Alfred E. Beach's Scientific American Tunnel.**

The proprietors of the SCIENTIFIC AMERICAN took more than a journalistic interest in invention. One of them, Mr. Alfred Ely Beach, was an inventor of note himself. To him we owe one of the first really successful typewriters and the first practical attempt at tunneling by means of a shield.

It was the transportation problem of New York, a problem which seems to have given as much concern in 1845 as it does now, that aroused the interest of the SCIENTIFIC AMERICAN in the possibility of constructing rapid transit subways. When hardly four years old, the SCIENTIFIC AMERICAN began the agitation of a rational engineering solution of New York's problem. In the issue of November 3rd, 1849, appeared an editorial entitled "An Underground Railroad in Broadway," in which we read:

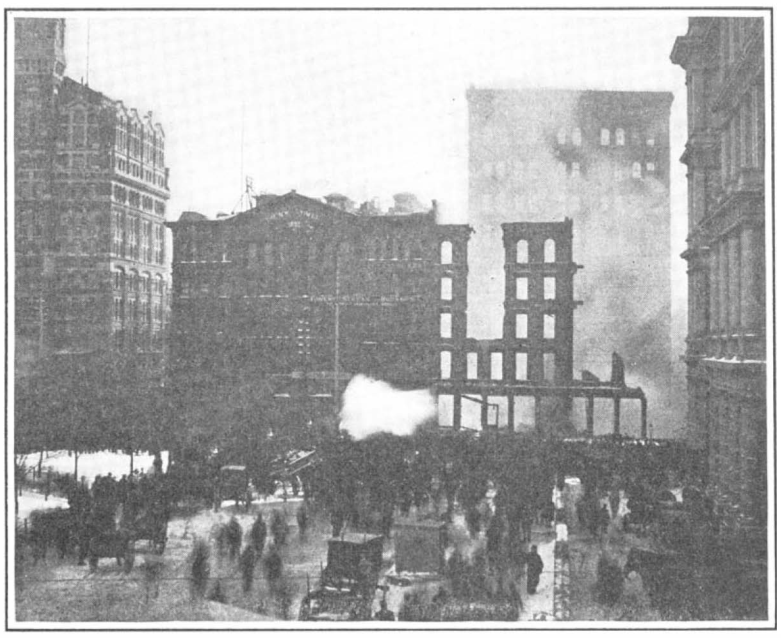
"The plan is to tunnel Broadway through the whole length, with openings in stairways at every corner. This subterranean passage is to be laid down with a double track, with a road for foot passengers on either side—the whole to be brilliantly lighted with gas. The cars, which are to be drawn by horses, will stop ten seconds at every corner, thus performing the trip up and down, including stoppages, in about an hour."

Year after year the SCIENTIFIC AMERICAN, in company with the newspapers of the day, berated the city authorities for their negligence in providing adequate transportation. Finally, Mr. A. E. Beach determined to attack the problem himself. Time and time again he had advocated the construction of a subway, only to be derided in the public press. His proposals must have been very exciting, for the New York *Times*, in its issue of March 15th, 1869, protested:

"It is said that the city is quite likely to grant a charter to build what is called an arcade railroad under Broadway. We would scarcely believe it. When this wild scheme was dismissed a year or two ago, we hoped and believed that we had heard the last of it—and so did everybody else."

Eventually Mr. Beach secured legislative authority to build a pneumatic tube from Warren to Cedar Street, through which parcels were to be blown from one end to the other.

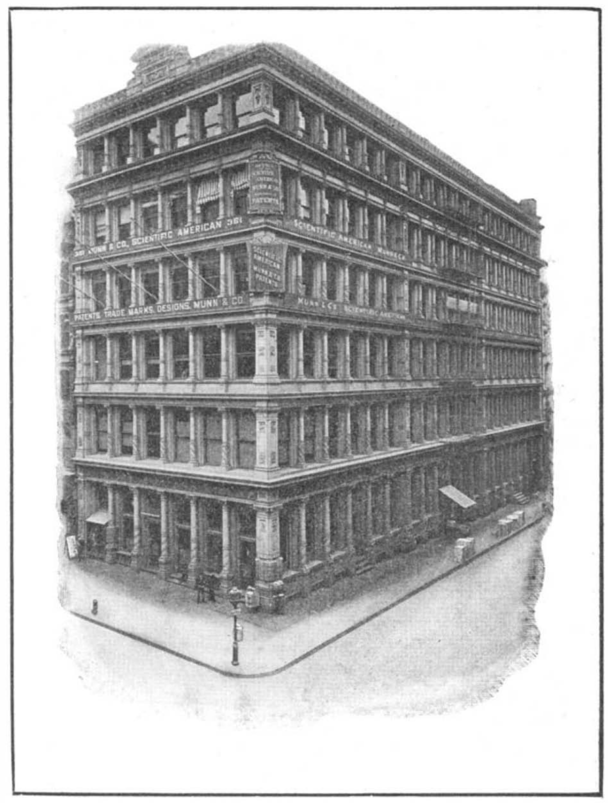
Obtaining a franchise meant the paying of tribute to the politicians of the day. Mr. Beach, therefore, determined to build his subway furtively, without the formality of asking for a franchise. In six nights, a gang of men had secretly dug out a tunnel extending from Broadway and Warren Street to Broadway and Murray Street. The dirt was carried to the cellar of a structure that occupied the site on which the Rogers-Peet Building now stands, and dumped there. A *Tribune* reporter, disguised as a workman, gained access to the subway. On the following day his paper published a complete exposure of the scheme. New York shared Horace Greeley's astonishment and indignation. To counteract the *Tribune's* attacks, and to prove to the public that the scheme was not utterly impracticable, Mr. Beach decided to throw the subway open to the public and to permit a general inspection of the tunnel, with its car and the big machine that blew the car from one end of the tunnel to the other. An admission fee of 25 cents was charged, and the proceeds were given to charity.



**On January 31st, 1882, the Scientific American Building on Park Row was destroyed by fire.**

Copyright by B. G. Mitchell.

**The Scientific American's new home in the Woolworth Building.**



**New York Office 1883-1915.**

What New Yorkers saw is thus described in the SCIENTIFIC AMERICAN of February 19th, 1870:

"Let the reader imagine a cylindrical tube, eight feet in the clear, bricked up and white-washed, neat, clean, dry, and quiet. Along the bottom of this tube is laid a railroad track, and on this track runs a spacious car, richly upholstered, well lighted, and with plenty of space for exit. The whole arrangement is as comfortable and cozy as the front basement dining-room of a first-class city residence. The tunnel has not only the positive comforts described, but is absolutely free from the discomforts of surface car travel. The track is single and level. It is not cold in winter. It will be delightfully cool in summer. . . . The air will be constantly changed in it by the action of the blowing machine. The filthy, health-destroying, patience-trying street dust, of which uptown residents get not only their fill, but more than their fill, so that it runs over and collects on their hair, their beards, and eyebrows, and floats in their dress like the vapor on a frosty morning, will never be found in the tunnel."

On the first day, a great stream of people passed through the tunnel, 21 feet beneath Broadway. At the Murray Street end stood the car. It fitted the tunnel like the carrier of a pneumatic tube, which it really was. The tunnel itself was "brilliantly illuminated" by gas, as one enthusiastic contemporary account remarks. Eighteen persons at a time took their seats in the car, were blown from one end of the tunnel to the other by compressed air from a 100 horse-power plant, and were sucked back when the blowing apparatus was reversed.

For a year the car traveled back and forth beneath Broadway. It was Mr. Beach's intention to excavate the whole length and breadth of Broadway, to lay his tracks, and to restore the street by building a roof over the trench—a complete anticipation of the "cut and fill" method which was actually adopted in constructing the present subway, many years afterward. New York was convinced. The *Times* ended by approving the system. But when Mr. Beach tried to have a bill passed authorizing him to complete his scheme, he found himself face to face with Tammany Hall. His bill was passed, but so was a Tammany bill, authorizing the construction of an elevated railroad at a cost of five million dollars, to be paid out of the city treasury. A Tammany Governor vetoed the Beach measure and signed the Tammany bill. The newspapers that had at first bitterly opposed the subway were in a rage. There was nothing for it but to close the short tunnel that had actually been built single-handed by the editor of the SCIENTIFIC AMERICAN.

After this experience, it is not astonishing

that the elevated railroad was hotly opposed in the columns of the SCIENTIFIC AMERICAN. The arguments advanced against the present structure that disfigures two of New York's principal avenues can be more fully appreciated now than they were then, verified, as they have been, by time and experience.

**Advocating Better Railways.**

Year after year, the SCIENTIFIC AMERICAN urged the need of better and speedier transportation, not only in the city of New York, but throughout the country. It performed a useful service in advocating the construction of transcontinental railways. As early as 1849 it began to agitate the advisability of linking the Atlantic and Pacific coasts by rail, and played a conspicuous part in the press campaign that molded public opinion and eventually brought that great undertaking to a successful consummation.

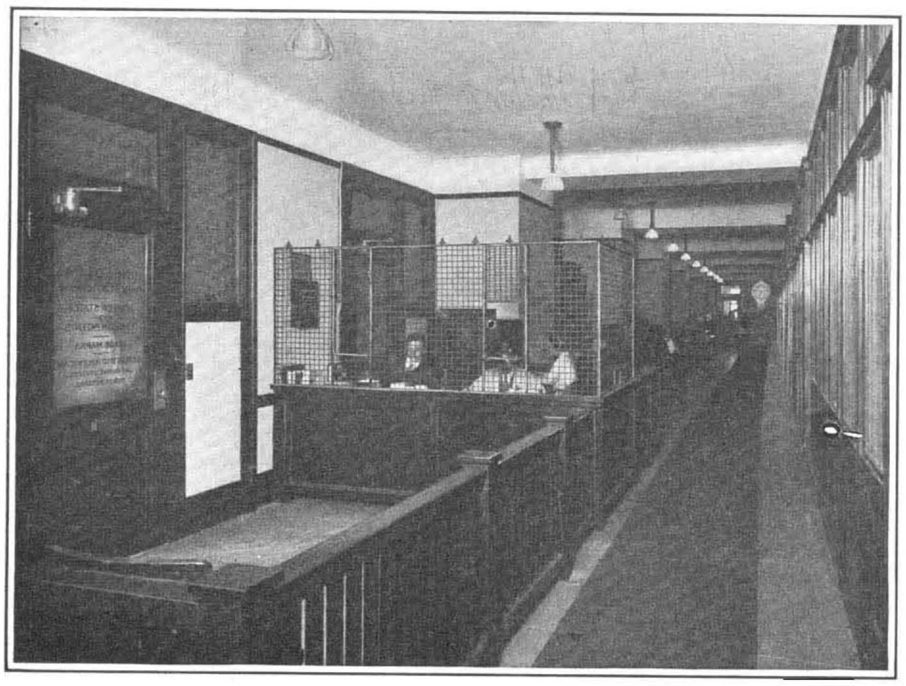
The possibilities of the Panama Canal, too, were early pointed out. In the very year of its foundation, the SCIENTIFIC AMERICAN broached the subject of the utilization of the Isthmus. The first projects proposed in the editorial column advocated a railway on which ships were to be bodily transported across the Isthmus. "Let a permanent double-track railway be constructed," said the SCIENTIFIC AMERICAN of November 28th, 1846, "and supplied with 32-wheeled cars; and ordinary merchant vessels may be transported from the Atlantic to the Pacific, or *vice versa*, in from ten to twenty hours." Hardly a year passed but some reference was to be found in the editorial columns of the vital importance of connecting the Atlantic and Pacific oceans.

**The Scientific American and the Automobile.**

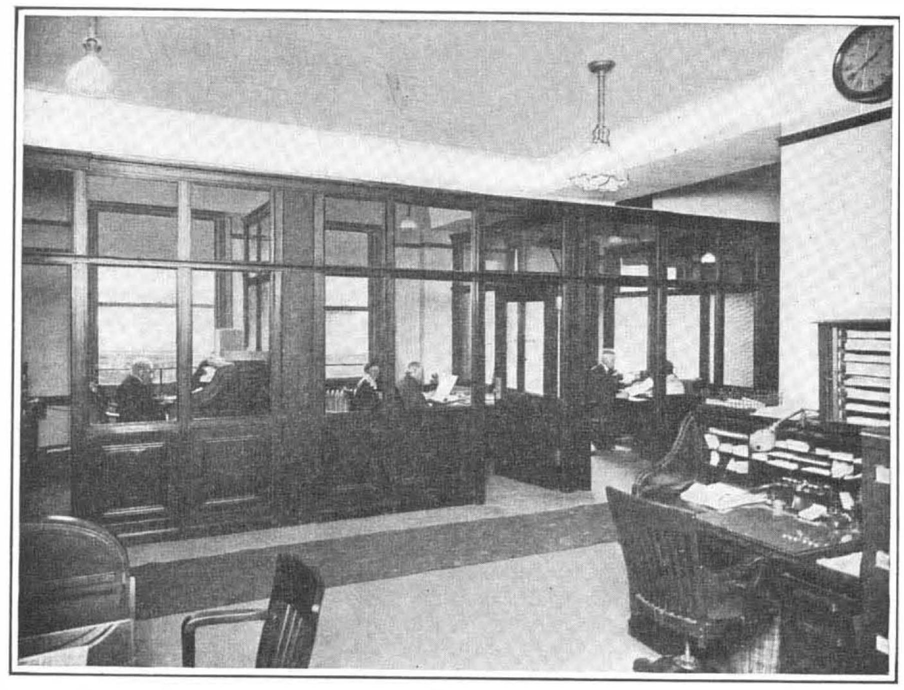
The automobile has been a familiar vehicle on our public streets only for the past twelve years. Forty years before its advent the SCIENTIFIC AMERICAN was publishing articles on the motor car, beginning with the fifth issue in 1845. Year after year, space was given to the ideas of inventors who knew that some day the motor-driven vehicle would displace the horse—gropings in the blackness of futurity, most of them; wonderful glimpses of later developments, many of them; poetic visions of meshing gears and puffing engines, all of them. It was through the SCIENTIFIC AMERICAN that the United States first heard of Cugnot, Trevithick, Guerney, Church, and Lénoir. When the automobile did appear at last, it seemed to its readers not like a sudden apparition, but as a vehicle with which they had always been familiar.

**The Scientific American and Aerial Navigation.**

Simultaneously with articles on automobiles appeared articles on aerial navigation. The SCIENTIFIC AMERICAN

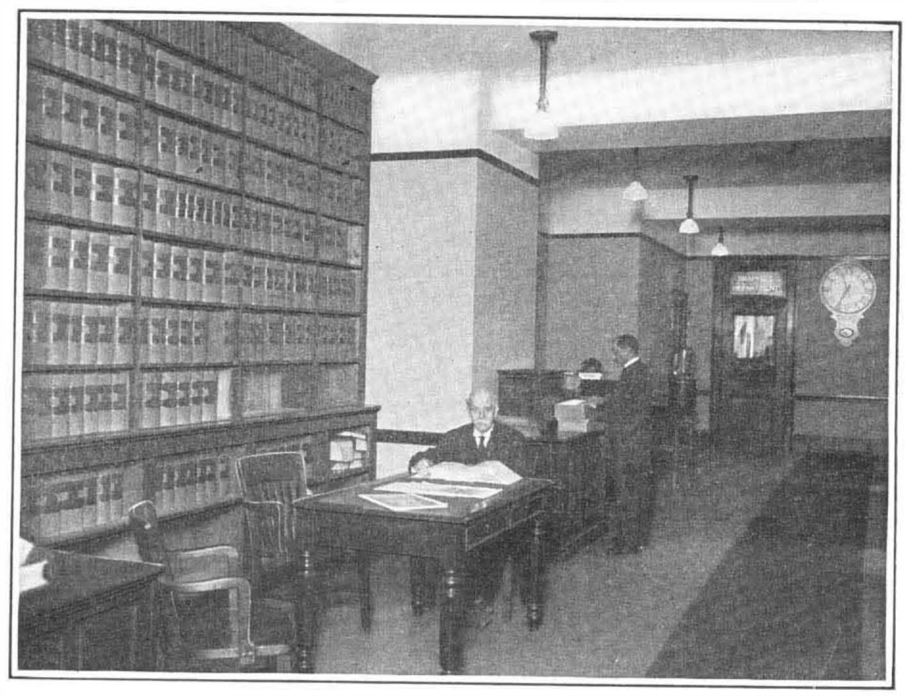


New offices of Munn & Co., in the Woolworth Building.

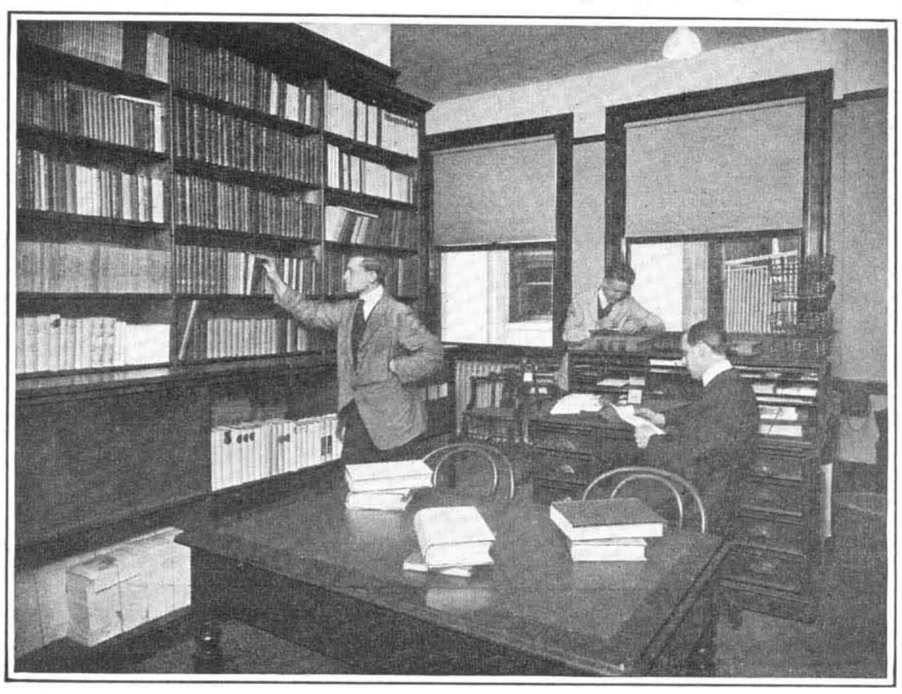


Three of the fourteen private offices of Munn & Co.'s patent staff.

Where the draughtsmen prepare patent drawings.



Library and Waiting Room, Main Office.



The Book Department.



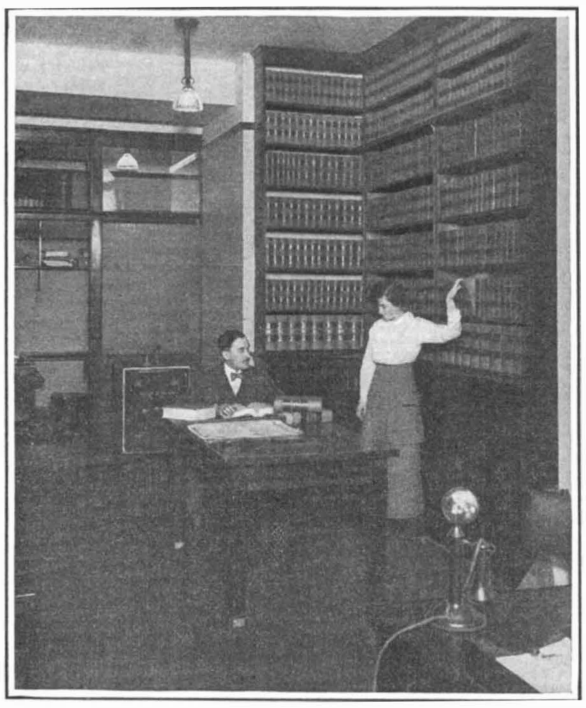
Where the correspondence, models and other records are filed.

was only four numbers old when its editor announced his intention of constructing a dirigible airship 350 feet long and 35 feet in diameter, a long cigar-shaped craft, that may well be regarded in some respects as an anticipation of our modern dirigibles. "To drive it," said the Editor, "we have already constructed and put in operation a steam engine and boiler, capable of working two horse-powers, but weighing only 200 pounds." He had the safety of his passengers in mind, too, for "the balloon," he states, "will be furnished with an improved parachute for each passenger, of which each may avail himself in less than one minute in case of extraordinary emergency, and thus descend safely on *terra firma*, much easier than he could paddle himself to shore on a cotton bale even from the middle of Long Island Sound." Encouraged by the Editor's optimism, inventors of aeronautic machinery turned to the Scientific American for advice and criticism. For over half a century it was the only periodical in this country that took the airship and aeroplane seriously and that devoted any amount of space to aerial navigation. Hence it was that the most distinguished aeronauts of the day were personal friends of the Editor. Among them was John Wise, the Nestor of American balloonists. He was not always pleased with the Editor's strictures, and voiced his disapproval in a spirited letter published in the issue of October 13th, 1849.

Although it believed in aerial navigation, the Scientific American performed a useful service by mercilessly ridiculing the more preposterous flapping wing machines and screw fliers and by publishing simply worded, accurate information for the benefit of the inventor of airships and flying machines.

And so the Scientific American contributed its share to the development of this newest of all methods of transportation, contributed it, moreover, by playing the part of an open-minded tutor. When the dirigible was scoring its first successes, and the heavier-than-air machine figured only in novels, the Scientific American insisted that the aeroplane was the air vehicle of the future. Langley's unsuccessful attempt to launch his man-carrying machine in 1903, was made the subject of derisive editorials in almost every newspaper of the country. The Scientific American alone defended Langley, and pointed out that his aeroplane was no more defective than a ship which had never been launched.

It is true that the Wright brothers were regarded with a skeptical eye at first; but that was because they flew in secret and would tell nothing. Later, when the Scientific American made an investigation and questioned citizens of Dayton, who had actually seen the machine fly, it became the Wright brothers' staunch support. What is more, the publishers offered the Scientific American $2,500 Trophy for flights by heavier-than-air machines, the first aviation prize of its kind in this country. Designed as a challenge trophy, the winning of which was to be made increasingly difficult as the art of flying progressed, the prize passed finally into the hands of Mr. Glenn H. Curtiss in 1910. When Mr. Edwin Gould cast about for a medium through which he could offer a prize of $15,000 "for the most perfect and practicable heavier-than-air machine . . . equipped with two or more power plants," he selected the Scientific American, for reasons that must have seemed obvious to those who knew how great a part the paper had played in recording the development of the flying machine.



The Law Library of Munn & Munn.

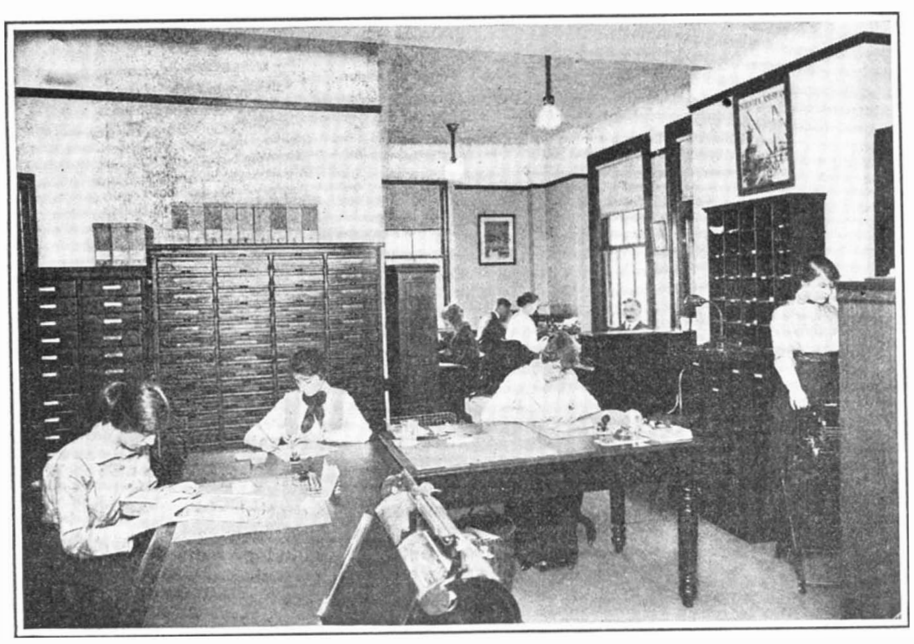
No less interesting to those who directed the destinies of the Scientific American than aerial navigation was the development of the modern battleship. From the year in which Ericsson's "Monitor" was launched (of which primitive craft the Scientific American published what was long the only authoritative picture) to the present day, every improvement in the ironclad fighting ship has been noted.

**The Scientific American and Its Subscribers.**

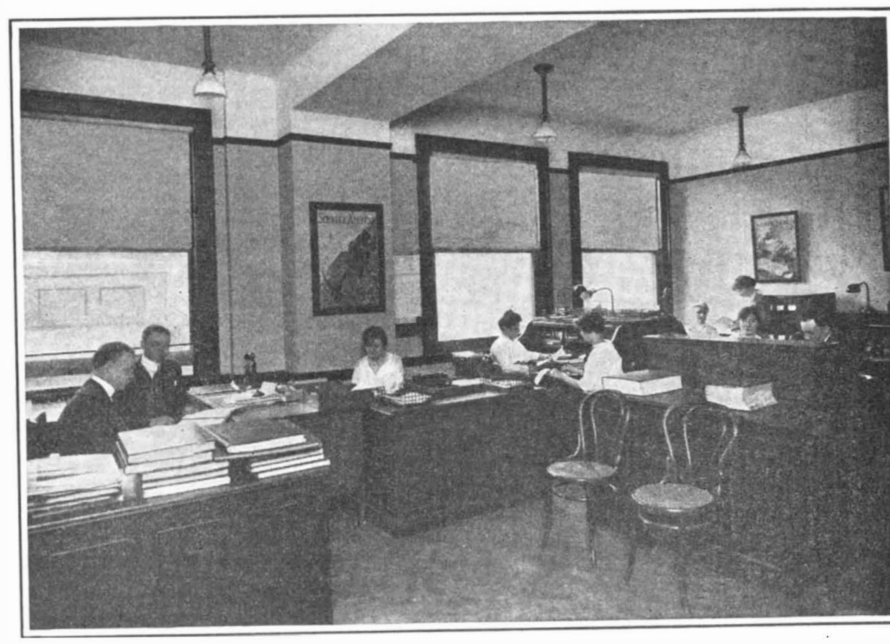
From the very inception of the Scientific American, the editor and the subscribers have been more closely connected than is usual, even in these days of paternal magazine editing. The periodical was always regarded by the publishers as something more than a mere commercial venture. They have always felt that they owed a duty to the subscribers, and a duty that did not end in giving an amount of printed matter equivalent in value to the price of an annual subscription. Accordingly, no letter asking the editor for information is allowed to go unanswered. Often the response entails an amount of research worth many times the amount of the subscription. As a mark of appreciation of the services thus rendered, Mr. T. R. Bowman of Adelaide, South Australia, voluntarily presented the Scientific American with a gold medal in 1899. The letter that accompanied his gift, which is probably unique in the history of magazine publishing, reads:

"I forward this trifle to the editor of the Scientific American as a souvenir of thanks for the many favors, information, and instruction I have derived from the perusal of the Scientific American for the last twenty-seven years; also for your kindness in giving me at different times information by letter."

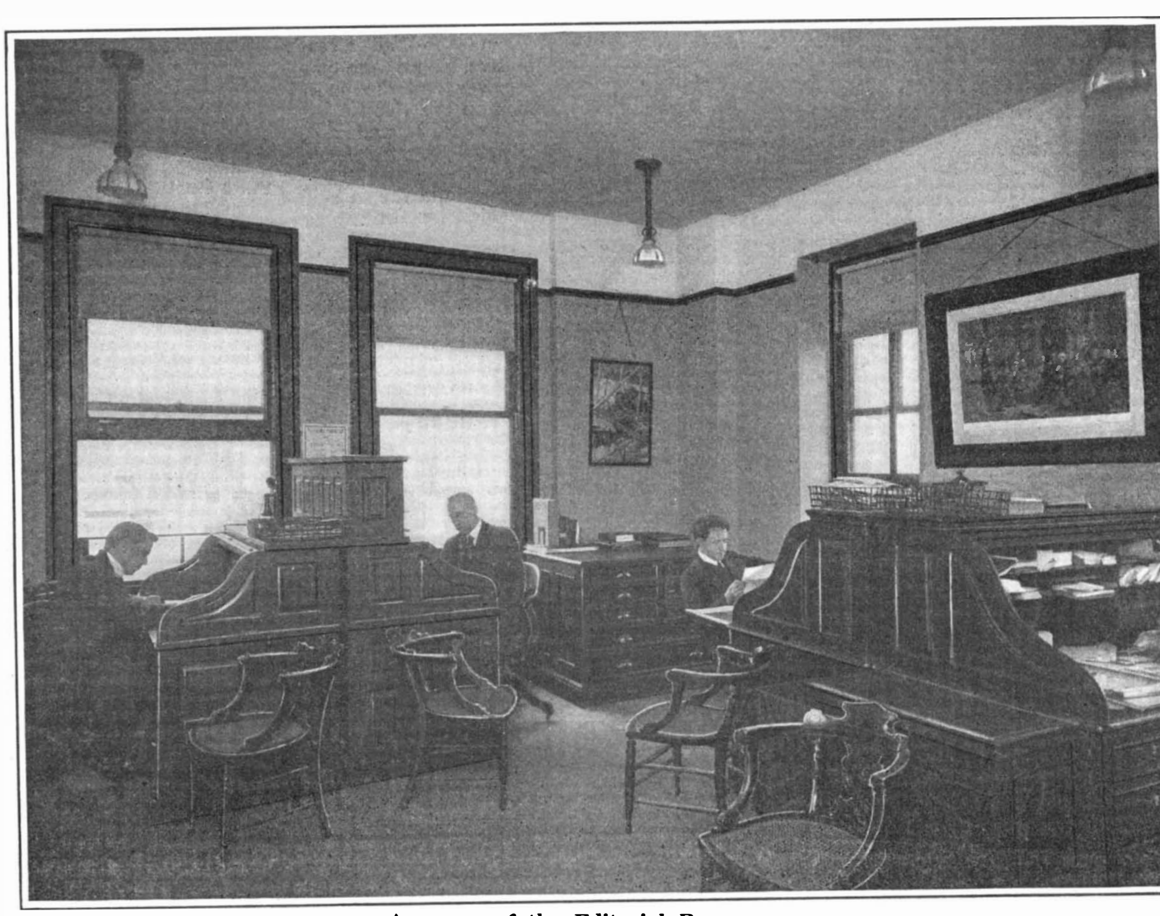
For several decades the Scientific American stood practically alone in the particular field which it covered. Launched in a new country, destitute of great libraries, great museums, or great universities, it served to a limited degree, it may be, but with distinct success, the purposes of all three. Not a few of the men who stand at the head of the great industrial institutions of the United States recall the hopeful days of their boyhood and their young manhood, when their chief source of instruction in the great happenings of that world in which they were about to make venture was the Scientific American. Thousands of men who are now engineers and manufacturers received their first inkling of mechanical electrical engineering from the pages of the Scientific American. Thomas A. Edison has related that as a boy he used to walk three miles every week to get his Scientific American. For nearly seventy years, issue after issue has explained with a simplicity that has appealed to every earnest student, unfamiliar with the phraseology of



Subscription Department of the Scientific American publications.



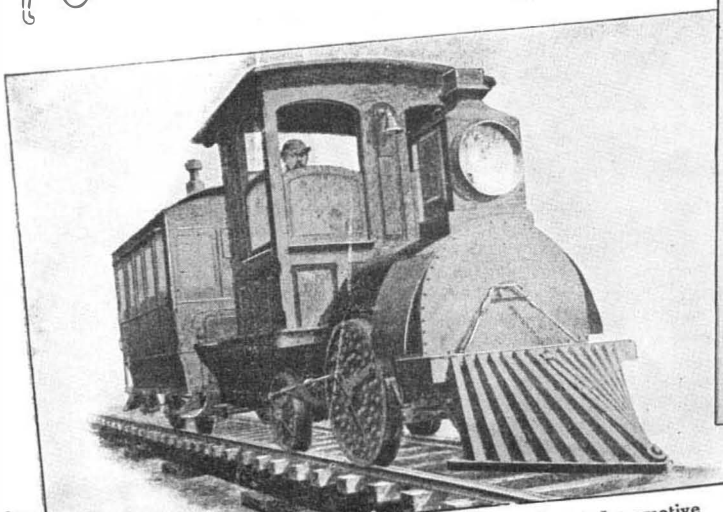
The Advertising Department of the Scientific American.



A corner of the Editorial Rooms.

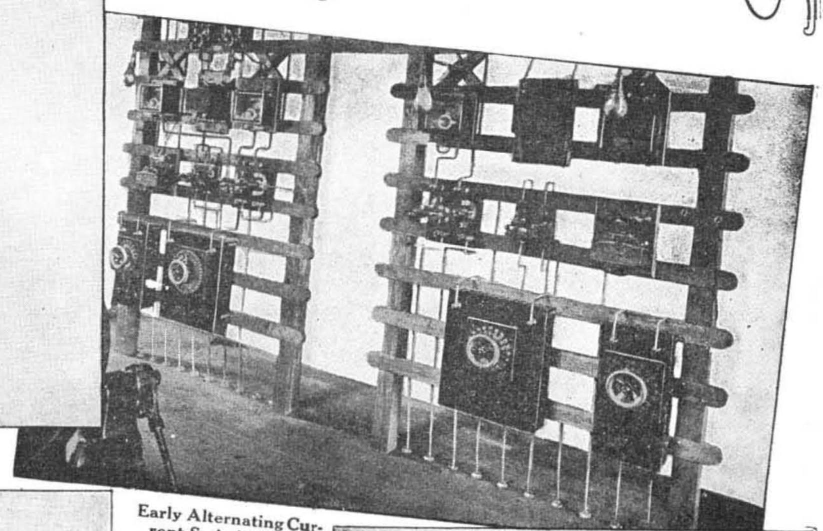
# MAKING A NEW INDUSTRY

## The Phenomenal Development of Electrical Apparatus in the Last Two Decades

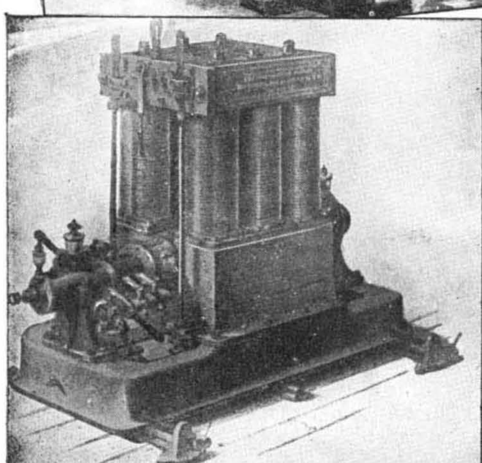


Electric Locomotive of 1880

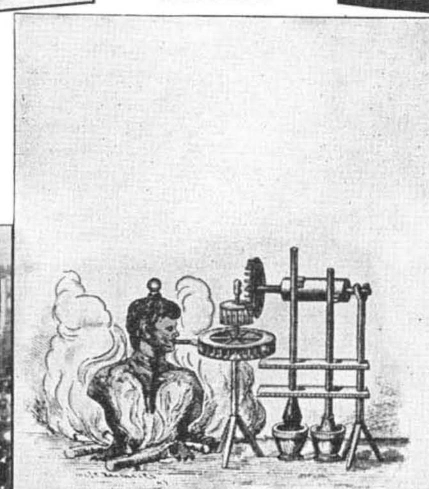
Edison's First Incandescent Lamp



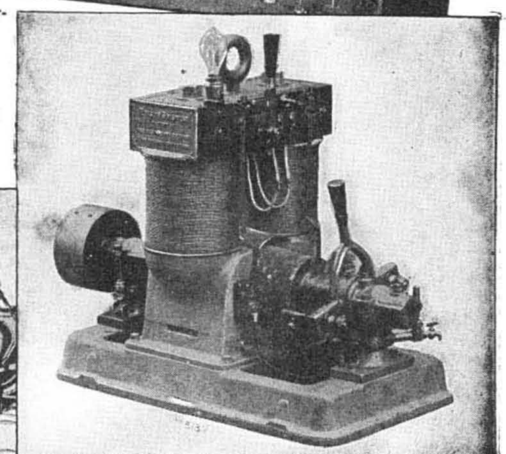
Early Alternating Current Switchboard



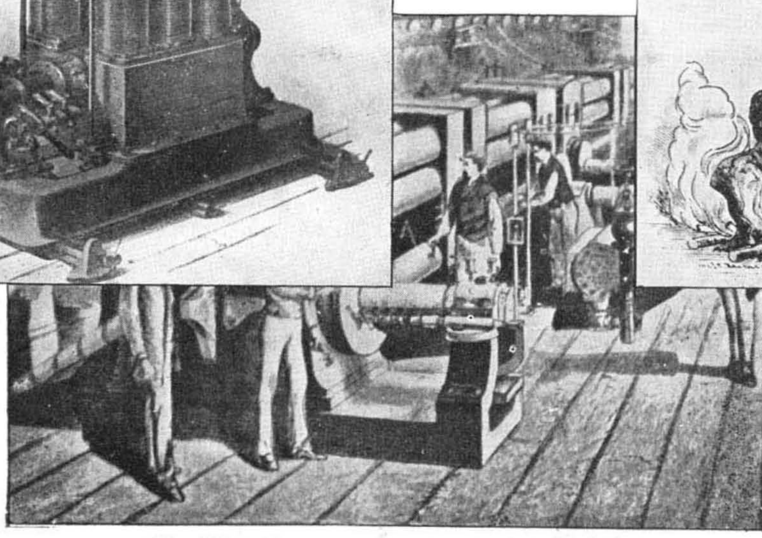
Early Type of Generator



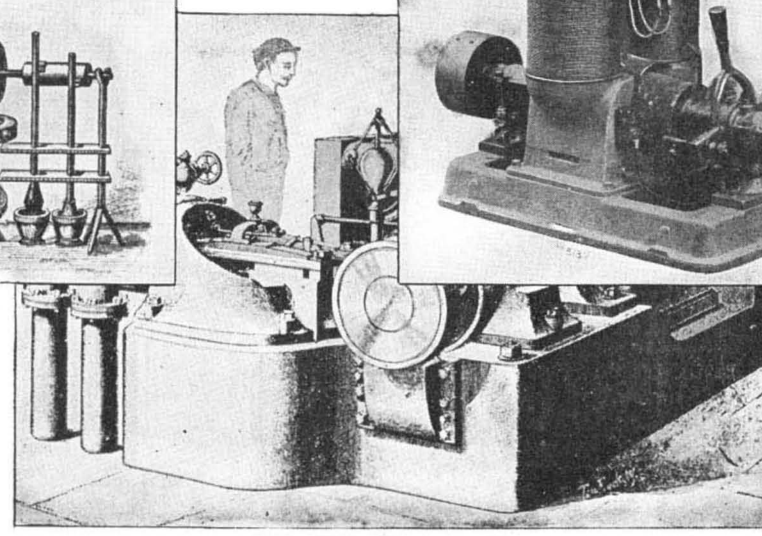
Branca's Turbine Engine



One of Edison's First Electric Motors



First Edison Electric Lighting Station in New York City



Edison's Menlo Park Steam Dynamo

**Only a few years ago Edison perfected the first incandescent electric lamp and built the first central distributing station in New York City. The advance of the electrical industry from this humble beginning, which is depicted above, has been truly wonderful.**

THE great industrial development of electricity began when the General Electric Company was organized in May, 1892. This marked the birth of a new industry, which was destined to become the marvel of the age in a few short years. Never in the history of manufacturing had such progress been recorded. Invention followed invention, discovery added to discovery, until it seemed as though the public was introduced to new electrical achievements every day.

The consolidation of several minor and struggling electric concerns into the General Electric Company was for the purpose of bringing together and harmonizing divergent methods and, by uniting different patents, of securing a more perfect product. Up to that hour, electric lighting, electric power and electric traction had remained in the experimental stage. Never before in the industrial world did organization effect a more magical change in releasing latent energy. Guided by master hands, electricity leaped into industrial pre-eminence. The value of manufactured appliances multiplied; invention took on added impulse; public confidence in electricity increased. The Company gathered together the ablest minds of the day and placed within their reach unlimited means and the resources of the world as an aid to inventive genius. Written throughout the wonderful development of electrical science and arts is the history of the General Electric Company.

### The Development of Electric Light

#### The Arc Lamp

Many years ago, in experimenting with electric phenomena, luminous effects were noted; but the actual history of electric arc lighting dates back only to 1875. Sir Humphrey Davy, with his chemical battery, in 1809 demonstrated the first crude arc light. But the arc lamp remained a costly laboratory experiment until the development of the dynamo in 1867. The modern period of arc lighting is credited to Z. T. Gramme, a Belgian inventor residing in Paris. His first patent was issued in 1870. In 1876 Jablochkoff, a Russian, perfected a method for controlling the arc, and the new lamps were soon in use in stores and streets. Charles F. Brush and Edmond Weston developed the series arc lighting now in use. The first Brush series arc lamp was erected in Cleveland in 1879. The first central station to operate arc lamps was the California Electric Light Company, in San Francisco in 1879. The arc lamp was the foundation of the electrical industry and the experimental work to sub-divide the arc led to the discovery of the incandescent lamp.

From this humble beginning have been developed the present luminous arc lamps manufactured by the General Electric Company. These are made in two general types, known as the pendant and ornamental types. The former is designed for general street lighting, while the latter is adapted particularly for lighting business streets, or so-called "White Way" lighting.

#### The Incandescent Lamp

When the commercial world demanded electric lamps similar to the gas lamp then in use, such inventors as Swan, Edison, Brush, Sawyer, Weston and Maxim directed their exclusive efforts to solve the problem. As early as 1841 De Moleyna patented in England an electric lamp of crude form, in which a platinum wire enclosed in an exhausted globe was made incandescent by electricity. A few years later Starr of Cincinnati devised another lamp consisting of thin strips of graphite enclosed in a glass globe. No permanent lamp resulted from this early work and the scheme was declared impractical up to the very day Thomas A. Edison produced the first successful electric lamp.

Thomas A. Edison, a young man who had already shown his wonderful genius by the invention of the quadruplex telegraph, the telephone receiver and the phonograph, began his epoch-making work on the electric lamp in his little laboratory at Menlo Park, N. J., and in the small Edison shops in New York City, nearly forty years ago. In those years of 1878 and 1879 work went on day and night, and the entire field of science and the world at large were ransacked for a suitable filament for the new lamp.

It was the twenty-first day of October, 1879, when Edison announced to the world that the incandescent electric lamp had been found. Bamboo was selected for the tiny hair-like lamp filament and the tropical world was searched for the different kinds of bamboo in order that the best might be chosen. For the next eight years the lamps were made with bamboo filaments, after which a squirted cellulose was used.

During the first ten years of the new lamp, its efficiency was increased to 3.1 watts per candle and a reasonable commercial life obtained. For nearly twenty years there was no improvement in the efficiency of the lamp until the technical staff of the Research Laboratories of the General Electric Company developed the metallized carbon filament of 2.5 watts per candle. This led to the development in Europe of processes for making filaments from several of the rare metals, such as osmium, tantalum and tungsten, and within a few years the Research Laboratories developed ductile drawn tungsten wire, which, with other improvements, revolutionized the lamp industry by increasing the commercial life of the lamp and reducing its consumption to 1.15 watts per candle.

While investigating the causes of discoloration in lamp bulbs, produced by the gradual disintegration of the filament, the Research Laboratories made another important discovery. *By filling the bulb with an inert gas the discoloration was reduced and at the same time it permitted the operation of the filament at higher temperatures.* Contemporaneously, a new method was found for mounting the filament. These improvements increased the efficiency of the lamp to 0.5 watts per candle in the larger sizes and to about 1.00 watts per candle in the smaller sizes.

The introduction and general adoption of the MAZDA lamp has been literally nothing short of a revolution in the art of interior illumination, with a correspondingly tremendous effect on exterior lighting.

### The Development of the Central Station Idea

The development of the central station in the past 25 years is one of the many modern miracles that electricity has brought into this busy and progressive world. The history of this wonderful growth is best told in the difference between the 6 kw. generators of the first central station and the mammoth 35,000 kw. machines of today.

The first central station was installed at Menlo Park, N. J., by Thomas A. Edison in the winter of 1880-81 to demonstrate the practicability of his new incandescent electric lamp. At the same time a central station system was started in New York City, the generating station being located near the corner of Fulton and Pearl Streets. The equipments consisted of six direct-connected units, each having a capacity of about seven hundred 16-candle-power lamps. This plant was started on the 5th of September, 1882, with 5,500 lamps connected. While this station was being equipped, a small water power station was built at Appleton, Wis., and placed in operation first. The development and growth of the central station, outside of New York, did not begin until some years later.

Today there are nearly 6,000 central stations in this country alone and the annual business totals many millions of dollars. The engineering talent of the General Electric Company has been devoted to the invention and design of central station and also substation equipment from the very beginning of the central station idea. Even after the invention of generators, motors and lamps, the manner of installation of these machines, methods of control, records of performance and systems of distribution of the current had to be devised and have been perfected constantly by this company. Apparatus of the General Electric Company is now operating in central stations in every section of this country and in almost every country in the world.

### Electricity Solves Transportation Problem

Early attempts to use electricity as a motive power resulted in a few scientific toys before 1882. Thomas Davenport, the Vermont blacksmith who invented the electric motor in 1835, constructed a toy car which ran around a circular track. Three years later a Scotch inventor made a small electric locomotive. A number of such locomotives were built during succeeding years until the Berlin exposition in 1879 when Messrs. Siemens and Halske constructed an electric line of about a third of a mile in length. The first regular commercial line in the world was at Lichterfelde, near Berlin, operated in 1880, but was not a success. Edison, Field, Van Depoele, Knight and many others experimented in electric traction at this time.

The first actually successful commercial electric railway, i. e., the first electric operation of the complete street railway lines of a city, was established in 1887 by Frank Sprague of the Sprague Electric Railway & Motor Com-

pany. in Richmond, Va. The road began operation in February. 1888, was essentially the overhead trolley system now used, comprised eleven miles of track, had thirty cars operating in July, 1888, and has been in continuous and successful operation ever since.

The phenomenal development and growth of electric street railway traction has revolutionized not only city, but also suburban and interurban transportation. In 1890 there were not more than 1,000 miles of electric railways in the United States. From this time up to the present, the mileage has steadily increased at the average of about 3,000 miles per year. In the development and improvement of motors and other apparatus essential to electric traction, the General Electric Company has figured with marked prominence.

In 1895 electric railway equipment reached what might be considered a staple basis of design. Fundamental features, such as the enclosed motor, carbon brushes, series drum winding, single reduction gearing, magnetic controller and the under-running trolley had then become established. There were in service at this time approximately 25,000 motor cars equipped with about a half a million horsepower of motors. A great many of the pioneer car motors were too small for the work, because early designers did not appreciate the amount of power required to accelerate a car. In 1895 the average rating of railway car motors was 25 horsepower. Other forms of street railway propulsion gradually disappeared until about 1900 when electric operation was practically supreme. There then existed some 20,000 miles of city electric railways. Principles of equipment design were on a far more scientific and practical basis. From 1900 to 1910 the electric railway extended rapidly to suburban and interurban transportation. Coincident with this development there was a tremendous increase in the size and weight of cars. The average horsepower of railway motors increased from 35 horsepower in 1900 to 65 horsepower in 1910, and large interurban cars were equipped with four motors, while city cars generally were equipped with two.

This increase in power brought about great improvements in controlling apparatus. The General Electric Company developed the multiple unit control for the operation of cars in train on elevated and subway lines, interurban roads and later for regular city surface cars. With the simplification of control were also introduced forced motor ventilation, reduction in the weight of motor equipments and increase in efficiency, improvement in commutation and introduction of commutating poles, perfection of air brake apparatus, introduction of field control, etc.

The necessity for more powerful locomotives for heavy grades, for larger train units and for a safer kind of power for tunnel service became apparent as early as 1895 in the Baltimore tunnel, where steam trains were continually becoming stalled on the grades. Electricity was then making such gigantic strides that the railroad officials appealed to electrical engineers for aid. The result was that the first electric locomotive for railroad service was manufactured by the General Electric Company and was installed on the Baltimore & Ohio. Thus this road, first in steam in 1830, became also first in electricity.

In 1899 the New York Central took up the study of electric traction for its New York terminal, to eliminate the congestion of traffic and remove the smoke nuisance. Nothing was done, however, until 1903, and in three years electric locomotives were hauling trains on this road. These electric locomotives operate at 600 volts, direct current. The General Electric Company built thirty-five in 1906, twelve in 1908 and sixteen in 1913 and 1914. The last six of these engines were at the time the most powerful electric locomotives ever built, and are capable of hauling 1200-ton passenger trains on level tangent track continuously at 60 miles per hour.

During this period electrification has been steadily progressing, until practically all the extensive steam railroad systems in this country and many abroad have tunnels, or terminals, or grades or certain sections of their roads electrically operated. On some railroads electric locomotives are employed exclusively both for freight and passenger service. The use of direct current has predominated in steam railroad electrification, and it soon became evident that the employment of high voltage would effect very decided economies in initial installation and operation.

The first rise to high voltage was from 600 volts to 1,200 volts. Many roads were equipped at this latter voltage, and next 1,500 volt installations were introduced. Then there was a most notable jump to 2,400 volts when the main lines of the Butte, Anaconda & Pacific were electrified in 1913. The General Electric Company built twenty-one electric locomotives and all the substation apparatus and equipment for this road. The next, and the most significant, step in railroad electrification is the extensive equipment now being built for sections of the Chicago, Milwaukee & St. Paul transcontinental railroad by the General Electric Company for operation at 3,000 volts direct current. The plans for electrification contemplate a total main line distance of 440 miles. Twenty-one 260-ton electric locomotives and all substation equipment are being constructed. The locomotives have a continuous rating of 3,000 horsepower and an hourly rating of 3,440 horsepower each, which makes them more powerful than any steam or other electric locomotive ever built. The electric locomotive has clearly outdistanced its steam rival, and it is not too sanguine to predict that the day is drawing near when electricity alone will operate all the railroads in the world.

## The Generator

A hundred years ago when Davy and Volta were experimenting with electricity, the current was secured from costly and cumbersome chemical batteries. It was in 1831 that Michael Faraday discovered that electrical current could be generated by moving conductors in a magnetic field so as to cut the lines of magnetic force. A year later H. Pixii invented the split commutator for reversing the current through the armature. Other improvements were made by J. Saxton, E. M. Clark and others. In 1857 E. W. Siemens improved the field magnetic and invented the shuttle armature. The dynamo became a commercial success in 1866-7.

When the General Electric Company came into the field, generators were, comparatively speaking, in their early stages of development and were manufactured entirely in small sizes. At first these machines were all direct current and of bipolar design. As the demand for greater power in single units arose, four, six, eight and a larger number of poles were employed in accordance with speed requirements with the increase in the size of the machine. Simplification of the design, improvements in methods and means of insulation and ventilation and greater efficiency through the introduction of commutating poles for direct current have been notable steps in the development of generators.

Probably the greatest advancement in the generation and use of electric current came with the invention and development of the alternating current machine. With the perfection of transformers and transmission facilities, the use of electricity for light, heat and power purposes then received an impetus that has carried it into almost every industry on earth. To the development of the alternating current generator may be ascribed in no small measure the marvelous industrial growth of this country.

The largest direct current generators ever built, of 5,200 kw. capacity, were manufactured by the General Electric Company for the Southern Aluminum Company, Whitney, N. C. It is also significant that the largest alternating current generators ever built are the product of this Company, forming a part of recently built 35,000 kw. single unit Curtis steam turbo-generators. In the largest hydro-electric power house in the world at Keokuk, Iowa, where 300,000 horsepower will be wrested ultimately from the Mississippi, are at present installed fifteen immense General Electric Company generators operating at the slow speed of 57.7 revolutions per minute and having a normal rating of 10,000 horsepower each. The production of waterwheel driven, alternating current generators has reached units of 17,500 kw., also of General Electric Company manufacture.

## The Electric Motor

Thomas Davenport, a poor, self-educated blacksmith of Vermont, constructed the first rotary electric motor in 1834, which embodies many of the first principles of the motors of today. Between the year 1835-60 a number of inventors perfected different types of motors. Jacobi in 1835 placed a motor to run a boat. Henry, Formant, Farmer, Siemens and others built motors. In 1852 Page succeeded in constructing a motor large enough to run a circular saw and a lathe. Davidson in 1842 ran an electric carriage about the streets of Glasgow. A motor of 10 horsepower was built in 1849 at Liverpool. Two important developments were in the inventions of the shuttle armature by Siemens in 1855 and the ring armature by Pacinotte in 1861. The real motor development began after Gramme's dynamos in 1871.

As in the case of the generator, the General Electric Company brought early prototypes of electric motors into their present commercially efficient state, and their development has been practically contemporaneous with that of generators. The successful development of the alternating current motor has likewise been especially advantageous to the advancement of industrial arts through electric drive. Special speed conditions, variable load and intermittent service have been peculiar problems of industrial drive that have been effectively solved through improved design and ingenious automatic controlling devices; and today, the motors manufactured by the General Electric Company range all the way from the smallest fractional horsepower sizes for domestic purposes and for direct drive of fine, delicate machines to the largest induction type motors ever built, 6,000 horsepower, driving immense steel rolls in the mills of the Indiana Steel Company at Gary, Ind.

## The Transmission of Electrical Energy

The development of electric transmission was the greatest boon to the industrial world in the history of manufacturing. The invention of the transformer enabled engineers to harness the most distant waterfalls and to bring this cheap energy within the industrial centers to turn the wheels of mills and factories, light the streets, run the street cars and railroads, illuminate buildings, etc.

It was about twenty-two years ago when the first 10,000 volt transmission line in this country was opened in Southern California, transmitting single-phase alternating current from San Antonio Canyon to light Pomona and San Bernadino, 14 and 28 miles away. In all there were forty 6-kw. transformers, the largest of that day, raising the voltage from 1,000 to 10,000 volts. One of the very first water power stations to transmit alternating current was the Gold King mine, at Talluride, Colorado, in 1890.

In 1877 Dr. Wm. Siemens indicated the commercial possibilities of electric transmission. Marcel Duprez, a Frenchman, sent 3 horsepower at 2,000 volts a distance of 24 miles over ordinary telegraph wires. In 1899 M. Hillairet, of Paris, transmitted 250 horsepower ten miles to run a motor in a paper mill. All these first experiments were with direct current. In 1891, 100 horsepower of alternating current was sent 108 miles in Germany with a loss of only 25 per cent.

These few installations immediately attracted the attention of such eminent engineers and inventors as Edison, Tesla, Thomson, Houston, Lord Kelvin, Stanley and others. From the work of these early investigators the perfection of transmission facilities has progressed steadily with the General Electric Company. The most notable transmission installation in history was recently effected with the Company's apparatus. It is known as the "Big Creek" development of the Pacific Light & Power Corporation, Los Angeles, Cal. At present 70,000 kw. are generated from four machines of 17,500 kw. each in two power houses from a combined drop in the stream of 4,000 feet. The current is generated at 6,600 volts and is stepped up by transformers to 150,000 volts for transmission to Los Angeles, 240 miles away. Thus the development of the transformer into the wonderful apparatus of today brings the power of mountain torrents to the heart of the great industrial centers.

## Switchboards

Not until the early eighties was the switchboard regarded as a necessary portion of the electrical equipment of a station.

For convenience switches were first mounted on the side walls of the station and as close together as their dimensions would permit. Following this period, switches and instruments were mounted on a wooden background removed from the wall to allow more space for wiring and the connections. This was the first switchboard. The next step was to substitute a wooden construction in the form of a rack or skeleton framework, which had open spaces through which the wires were brought from behind the board to the connected equipment in front.

From this simple beginning, switchboard development by the General Electric Company has passed through many wonderful inventive stages. The switchboard is now one of the most important pieces of apparatus of the industry. It consists of as many panels as necessary, usually of slate to provide safety, and combines a multitude of instruments and devices for controlling, distributing and recording automatically if wished, the flow of electric current to one or a hundred or more circuits or machines in almost any quantity or way desired. Probably the most notable switchboards ever built were recently constructed by the General Electric Company. These are the highly special types of great remote control boards that control and indicate every movement of all the massive lock machinery in the Gatun, Pedro Miguel and Miraflores locks of the Panama Canal.

## The Turbo-Generator

The turbine steam engine is fully 2,000 years old. It was described by Hero, of Alexandria, in his "Pneumatica" about the year 120 B. C. Branca, of Italy, used a small steam turbine to run a little drug grinding mill in 1629 A. D. Thus the turbine was the first steam engine, although the last to be developed.

The first commercial turbine was produced in England in 1884. In 1903 Prof. C. G. Curtis, of New York, in conjunction with the General Electric Company, produced the first vertical steam turbine engine. These turbines are principally used to drive electric generators and have been developed by this Company from the small size of 5 kw. to the largest engine in the world, a single horizontal unit of 35,000 kw. capable of delivering some 50,000 horsepower.

The development of the Curtis steam turbo-generator in the short space of twelve years has thus been nothing short of marvelous. The remarkably high efficiency of these units and the exceptional economy of space secured through the principle of their design has revolutionized the production and distribution of energy from steam. At first the Curtis turbo-generator was built in the horizontal type, then the vertical type, and now the design for all sizes has reverted to the original horizontal construction. During this period improvement after improvement has followed both in the mechanical and electrical components of the machines. It would be physically impossible to build reciprocating steam engines in units of the enormous capacity of the large Curtis steam turbo-generators. The great space such engines would occupy and their lower efficiency in comparison with the turbine would render them wholly impractical to use if they could be built. The Curtis turbo-generator of the General Electric Company may be said to be one of the foremost factors in the vast concentrated production of energy from steam and its consequent economical distribution as heat, light and power in the many thousands of cities, towns and rural communities in this country.

## Electricity as a Source of Heat

Notwithstanding the ease with which electrical energy can be changed into heat, and this knowledge was patent to the earliest experimenters, it was only a few years ago that electric heating and cooking devices were introduced to the public. Sir Humphrey Davy, a hundred years ago, with his first carbon arc, melted and fused all known substances. Diamonds, quartz, rare metals were easily melted down; carbon boiled quickly away; even the fire bricks of his crude oven were consumed.

The secret of nearly every electric heating or cooking device is a carefully proportioned bit of resistance wire, or stamped resistance metal, imbedded between insulators and usually enclosed within the device itself. In many places where heat is required in manufacturing, electricity is generally used. The most important installations are for electric welding, electric smelting, electric tempering baths, etc. It is also utilized in a thousand other ways. Electricity for domestic cooking has already reached such a high stage of perfection that the electric range can be said to compare favorably with gas or coal ranges. Probably the most popular heating device is the electric iron now in use in millions of homes. Electric heat is also used for culinary purposes in many of the largest restaurants and hotels. In all these fields the General Electric Company has developed efficient devices and apparatus.

## Auxiliary Electrical Apparatus

The auxiliary electrical apparatus that has been invented and improved in the works of the General Electric Company may well be said to cover practically the entire field of the application of electric energy. An enumeration of these devices would be legion. Along with the development of important apparatus came also the invention of much special machinery for making it. The distribution of electric current involved the production of hundreds of wiring devices and accessories, plugs, sockets, receptacles, fuses, switches, etc. Then there are measuring, protective and controlling devices and other apparatus, such as ammeters, voltmeters, circuit breakers, voltage regulators, feeder regulators, signal accessories, rheostats, lightning arresters, insulators, rectifiers, controllers, oil switches, dimmers, projectors, motor-generators, synchronous converters, and scores of other apparatus and equipment.

## The Future of Electricity

The making of the electrical industry has been so rapid because of the overwhelming magnitude of the potentialities of this most flexible and efficient form of energy, that the skilled scientists and engineers of the General Electric Company have bent every effort in order to keep pace with the constantly growing demands for its application. They are ever reaching out into new and greater spheres of activity for this universal servant of mankind. No one can foretell its marvelous future; yet so extensive even now are the applications of electric energy, we are impressed that electricity, the mysterious force we know of but do not yet know, is coming more and more to do the world's work.

GENERAL ELECTRIC COMPANY
SCHENECTADY, NEW YORK *Advertisement*

more technical periodicals and books, how dynamos, galvanometers, batteries, telescopes, steam engines, lathes, and wireless apparatus are constructed and how they operate.

The late George M. Hopkins, long an editor on the staff of the Scientific American, designed much of this apparatus himself. What is more, he built every piece with his own hands before publishing its plans and specifications in the Scientific American. "Experimental Science" was the title under which his lucid articles were afterward collected in a book now in its twenty-seventh edition. It was in truth science of the most practical and instructive kind, and it filled a decided want at a time when manual training schools were practically unknown in this country.

**Exposing Swindlers.**

As the Scientific American ministered to the intellectual requirements of a pre-eminently practical nation, so it guarded its financial interests when they involved machinery. Swindling schemes, based on supposedly revolutionary inventions, are encountered with less frequency now than formerly, chiefly because we have a large class of trained technical men to fall back upon for expert advice. Thirty years ago it was otherwise. The late John W. Keeley, of blessed memory, who talked with the glib obscurity of an Indian Swami and was possessed of the audacity of a Cagliostro, was the prince of these swindlers. Year after year, the Scientific American jeered at his "etheric vapor," his vibrators, his resonators, and the mysterious forces that served to discharge his etheric weapons and to operate his engines. The editor took the trouble to build a duplicate of Keeley's "etheric gun," to prove that it was operated by compressed air. When Keeley died in 1899, still gaining the ears of a rapidly dwindling number, still living on the spoils of the mechanically ignorant and credulous, the Scientific American made a thorough examination of his laboratory at 1420 North Twentieth Street, Philadelphia. Every piece of flooring was torn up, and every nook and cranny searched. The investigation turned out exactly as the Scientific American had predicted twenty years previously. Keeley's "etheric vapor" proved to be compressed air.

There were other schemes besides Keeley's—all of them forgotten now, but as alluring to the unwary investor of earlier days as the possibilities of mines which exist only in the imagination of a Wall Street promoter to the simple-minded stock gambler of our own time. In exposing them, the Scientific American probably saved many a reader from serious financial loss. Among the schemes effectually disposed of were the carbonic acid motor, the gunpowder engine, the chloroform engine, and various perpetual motion contrivances.

**The New Home of the Scientific American.**

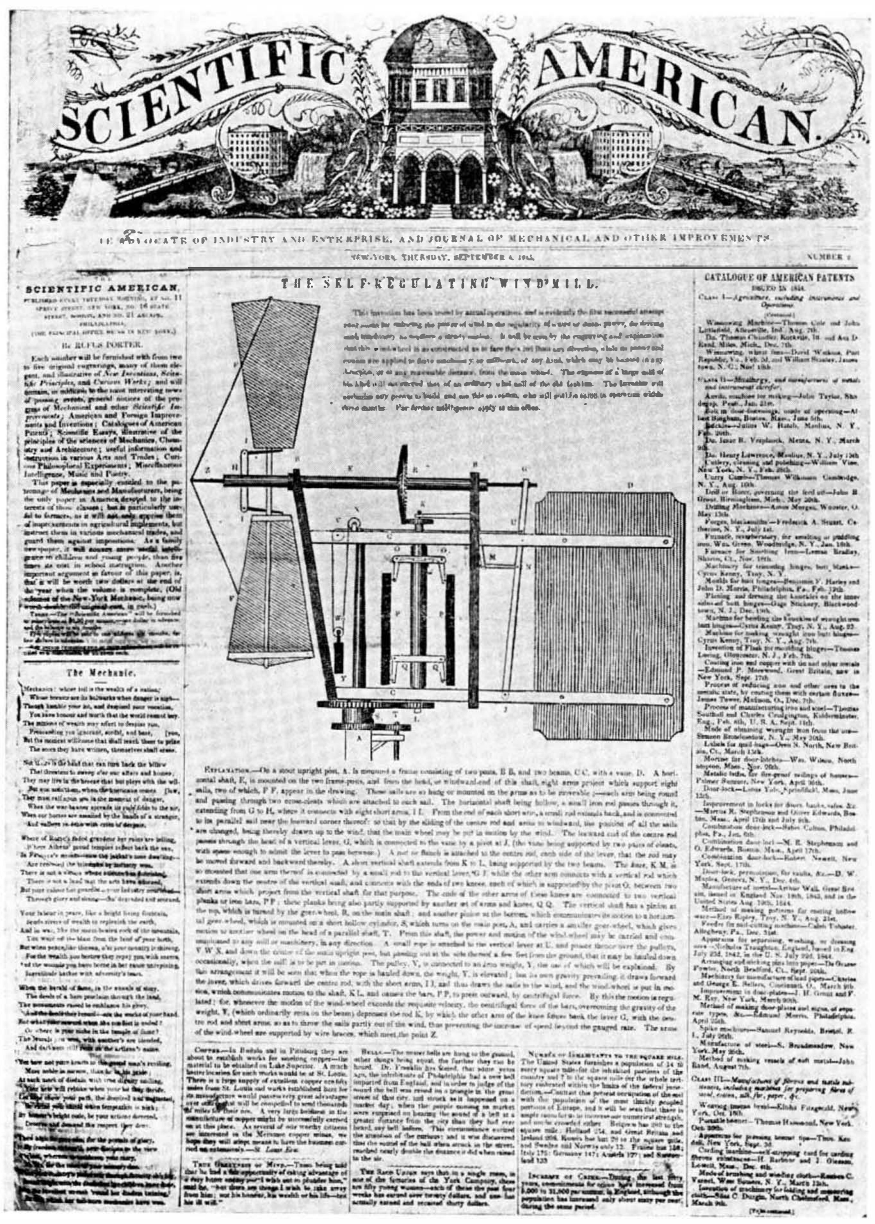
Although it has grown healthily during the seventy years of its existence, the Scientific American has occupied but five different buildings. The first home of Munn & Co., as we have said, was located in the old Sun Building, which then stood at the southwest corner of Fulton and Nassau streets. There the paper prospered for a number of years until the old quarters were found too small, particularly for the patent soliciting department. New and commodious offices were, therefore, secured in the original New York World Building, at 37 Park Row, at the corner of Beekman Street, to which location the publication was moved in 1859, and this was its home until January 31st, 1882, when the building was completely destroyed by fire. Practically all the valuable records and papers that had been accumulating for years were lost.

The period from 1859 to 1882 had been one of unusual prosperity for the Scientific American. It had gained readers in every part of the country and in foreign lands, and had won for itself a reputation as an authority on technical matters. No time was lost in securing temporary quarters, and publication was continued without a break from No. 261 Broadway, at the corner of Warren Street. Here the offices were maintained until 1884. In that year the establishment moved to No. 361 Broadway, at the corner of Franklin Street, where two commodious floors were occupied until the present spring.

After thirty years at No. 361 Broadway, it was felt that more modern quarters were needed—quarters that harmonize with the character of the Scientific American and the patent soliciting of Munn & Co. The Woolworth Building, the tallest and most modern structure of its kind in the world, was selected as the new home of the Scientific American and of Munn & Co. Two wings of a whole floor now house the staff of the Scientific American and the Patent Department of Munn & Co. The new home of the Scientific American and Munn & Co. is not only more commodious than the old, but is well equipped with conveniences of all kinds so that the businesses of publishing an important periodical and soliciting patents can be conducted with even greater efficiency than before.

## Patent Office Salaries and Expenses Seventy Years Ago

The seventieth anniversary of the Scientific American leads us to compare the expenses of the Patent Office seventy years ago with those of last year. The Patent Office salaries in 1845 amounted to $15,545.20 and $4,097.09 was paid to temporary clerks, and the total expense of running the Office, including postage, library, compensation of district judge and $2,392.41 for agricultural statistics, amounted to only $31,172.32; and even with such a small expense the Office earned a net balance of $11,680.49 to be credited to the Patent Fund,


SCIENTIFIC AMERICAN.

THE ADVOCATE OF INDUSTRY AND ENTERPRISE, AND JOURNAL OF MECHANICAL AND OTHER IMPROVEMENTS.

THE SELF-REGULATING WIND-MILL.

CATALOGUE OF AMERICAN PATENTS

The Scientific American in 1845.

which even at that early day was of respectable proportions.

For the year ending December 31st, 1914, the Patent Office salaries amounted to $1,307,092.13 and its total expenditures were $2,000,770.12, with a net surplus for the year of $251,122.70.

In his report dated January, 1846, the then Commissioner of Patents said:

"I will embrace the opportunity to state that I have received from Prof. Morse an interesting account of the different magnetic telegraphs now in operation in Europe made up from materials obtained by personal examination. I am happy to say that Prof. Morse's own brilliant invention by which thought is converged with the rapidity of the lightning flash is eminent over all others of a similar character now in use in Europe."

## The Scientific American and the Planing Mill Monopoly

In the early days of the last century William Woodward, an old carpenter familiarly known as "Uncle Billy" in his home town of Poughkeepsie, N. Y., invented a machine for planing lumber. This machine was provided with rotary cutters and feed roll. A patent was granted to Woodward in 1828, on his planing mill. But being entirely inexperienced in pushing his invention, he could do nothing with it, in face of the strong opposition of carpenters, who saw in the invention nothing but a means of robbing them of their living. Indeed, he had to watch his machine carefully lest it be burned by the hostile journeymen carpenters.

In those days the term of a patent was fourteen years, but by special act of Congress, the term could be extended seven years more if the inventor could show that he had made no adequate profit out of his invention. This William Woodward was obliged to do in 1842. Shortly after, he succeeded in selling his invention to a group of men, each being assigned a certain territory. These men, however, combined their interests and fixed the terms upon which the planing mill could be used. No machines were sold, but in each district a few machines were leased under a contract which bound the lessee to charge a certain fixed price for the work done by his machine. By this means a firm grip upon the lumber industry of this country was obtained. It was impossible for hand labor to compete with the machine, and practically all the business in dressed lumber was thus put under the control of the planing mill trust.

In 1845 the original Woodward patent was surrendered and reissued. In 1849, when it was due to expire, sufficient influence was exerted upon Congress to prolong the patent by another seven years, even though it could hardly be claimed that the patent had not proved a profitable investment. There was a storm of protest all over the country, which mattered little, for the extension had already been granted. However, preparations were made to prevent any further extensions of the patent.

In 1856, which was the year in which the second extension of the patent was due to expire, it was evident that influences were at work to have Congress grant a third extension. At this juncture the Scientific American took a hand in the fight. It was a young journal at the time, but already it had a long and influential list of subscribers. It began an attack upon the Woodward interests in a series of editorials, and sent out form letters of protest to all its subscribers for their signatures and those of their friends. The patent was due to expire on the 26th of December. Early in December a bill was introduced in Congress for the further extension of the Woodward patent during a term of seven years. The planing mill interests had their lobby workers busily engaged and it was rumored that money was being spent freely. It looked as if nothing could overcome the determined efforts of the Woodward party. It was then that the protest prepared by the Scientific American was brought in. It was a huge document, "as big as a roll of carpet," they say, containing the signatures of between fourteen and fifteen thousand citizens. It was never read, but it was spread out on the floor and measured with a tape line. The document was found to be fifty feet long and contained two columns of closely written names. That was enough for Congress. The bill died, and the planing mill monopoly came to an abrupt end.

**An Intensive Climatological Survey.**—Writing on "The Dollars and Cents Value of California Meteorology" in the *University of California Chronicle*, Mr. Ford A. Carpenter, of the Weather Bureau, describes a remarkable instance of a climatological survey in connection with a land development project. The location is a tract of land in southern California, 15 miles long by 5 wide, lying along the sea and rising therefrom in benches and terraces to an altitude of 1,500 feet. Town sites, harbors, hydroaeroplane stations, roads and railways are to be laid out within this tract, and as a guide to their location as well as for the purpose of placing relative values on the parcels of land for country homes and intensive farming, the climatic conditions of the tract are being studied in a most thorough way for a period of one year, dating from last June. Automatic meteorological instruments have been erected throughout the property, the record sheets are corrected and computed, and the great volume of data thus secured will be digested. Thus a detailed knowledge will be obtained of the climatic conditions pertaining to every 10-acre plot in a tract of 16,000 acres. This undertaking is probably without precedent. Of course, in a region of less equable climatic conditions than southern California such a survey would need to be prolonged over a period of many years to give trustworthy results.

## RECENTLY PATENTED INVENTIONS

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

### Electrical Devices.

ELECTRICALLY OPERATED TIME SWITCH.—J. W. PENNEWILL and M. R. BUCHANAN. Address the former, Silver City, New Mex. The switch is especially adapted for lighting circuits whereby the lamps can remain lighted only for predetermined intervals so that there will not be a waste of current by the lights being kept burning when they are not needed, such a switch being especially useful in refrigerating or cold storage rooms where the employees are likely to leave the lamps in circuit negligently when they pass out of the room after having performed the duty that necessitated their entrance.

### Of General Interest.

DISPLAY RACK.—O. F. KIME, Crestline, Ohio. The invention relates to racks for displaying articles for sale, such as rugs, and the main object thereof is to so support a plurality of said articles as to be readily displayed individually. It provides a rack from which any desired one of the articles can be easily removed, without disturbing any of the articles thereon.

CORD LEAD.—S. HEYMAN, care of H. Blumgarden, cor. Graham Ave. and Varet St., Brooklyn, N. Y. This improvement relates to guides or leads for cord, cables and the like, and provides an improved construction designed to lead or guide a cable from one side of the wall to the other, so that the wall will normally be closed and solid, but a free passageway will be provided for the cable.

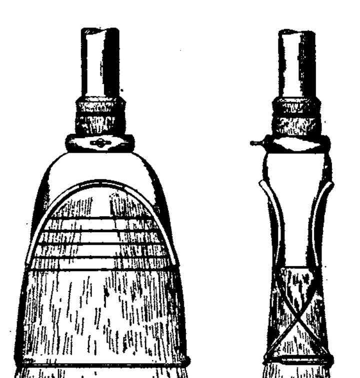
CHUTE.—O. E. WEST, Box 87, Brunswick, Ga. This invention relates to chutes, the more particular purpose being to provide a device suitable for general use and of especial service for depositing loose material, such as phosphate rock, in the hold or other predetermined portion inside of a marine vessel.

SCREENING APPARATUS.—J. J. PHILLIPS, Brookhaven, Miss. This apparatus is more especially designed for screening clay and like material and arranged to separate the finer particles from the coarser ones and deliver the same to different chutes so that the finer particles pass directly to the brick-making machine while the coarser pass to the dry pan to be treated further.

MATCH BOX.—R. DICKSON, 29 Mt. Royal Ave., Hamilton, Ontario, Canada. This invention provides a structure which will vend matches one at a time, and will also automatically strike or ignite the same; provides a vending match box which will disclose to view the matches to be vended, and which is provided with a magazine for reloading the vending part of the box; and provides for vending one match at a time.

### Household Utilities.

BROOM PROTECTOR.—J. RABASA, 139 W. 10th St., New York, N. Y. An object in this invention is to provide an improved structure which may be rapidly applied and removed and while applied properly hold the straws or fibers



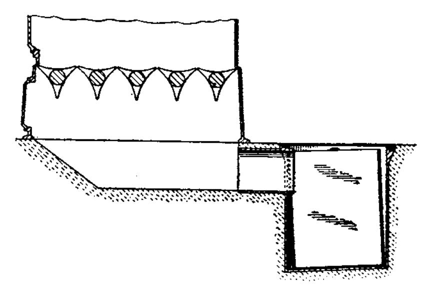
BROOM PROTECTOR.

in position. Another object is to provide a protector which will protect the upper part of the broom and also the broom intermediate the length for preventing the spreading of the broom straws while the broom is in use.

PUMPING MECHANISM FOR VACUUM CLEANERS.—H. ECKEL, 215 North Milton Ave., Whittier, Cal. This invention relates to vacuum cleaners of the type employing a casing and one or more bellows, together with a dirt receptacle, the purpose being to produce a neat and compact vacuum cleaner having a minimum of parts, and all of its parts being readily accessible.

SANITARY SHIELD.—ELEANOR L. BAINBRIDGE-BELL, Mount Bethel, Pa. This invention relates to sanitary shields for seats of water closets, and one of the main objects thereof is to provide such devices in the form of sheets of paper, preferably medicated, having protecting curtains connected therewith when in use, but which present no loose or flapping members before use.

ASH RECEPTACLE FOR FURNACES.—ALBERT B. MEYER, Chicago, Ill. This invention relates to devices for removing ashes from the ash pit of furnaces, without stirring up dust and dirt. In use the ashes which have dropped from the furnace grate-bars to the pit there-

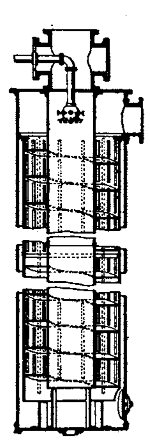


ASH RECEPTACLE FOR FURNACES.

under are pushed through a spout by means of a shovel or the like, into a suitable receptacle which is provided with a removable cover plate, normally in closure position to prevent the escape of dust. After the dust has settled in the receptacle, the latter will be removed after swinging the cover plate open. Thus the ashes can be removed without raising any dust.

### Heating and Lighting.

GAS SCRUBBER.—W. M. DERBY, care of Standard Oil Cloth Co., Buchanan, N. Y. The invention provides a gas scrubber having a spiral member for directing the gas in a circular path so that all the impurities and moisture will be directed outwardly to be deflected by flanges through openings in a wall



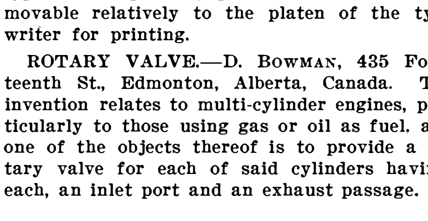
GAS SCRUBBER.

at the outer side of the spiral. It also provides means, among others, for directing gas downwardly and spraying it at the inner side of the spiral to cool and remove some of the impurities, the gas then being permitted to pass upwardly through the spiral.

### Machines and Mechanical Devices.

TYPE WRITER.—S. A. THOMPSON, 644 First Ave., New York, N. Y. The invention relates to machines in which a printing structure, preferably in the form of a wheel, is employed, the same being provided with fingers, carrying the printing types on a face thereof. The printing structure is mounted on a frame for movement in its own plane for locating a type at the printing point, and the frame is movable relatively to the platen of the type writer for printing.

ROTARY VALVE.—D. BOWMAN, 435 Fourteenth St., Edmonton, Alberta, Canada. The invention relates to multi-cylinder engines, particularly to those using gas or oil as fuel, and one of the objects thereof is to provide a rotary valve for each of said cylinders having, each, an inlet port and an exhaust passage. In



ROTARY VALVE.

this valve the split construction prevents any tendency to bind when the valve becomes heated and also to the pressure during the power stroke being borne by the shaft running on ball bearings. No amount of water will affect the timing or area of opening of the valve. The operation is noiseless and easy.

TYPE WRITER ATTACHMENT.—G. W. PALMER, 3113 Ricard Bld'g., Seattle, Wash. This invention provides an attachment capable of quick connection to a type writer or detachment therefrom for supporting a roll of gummed or plain paper for receiving addresses, and designed for attachment to envelopes, circulars and the like, or for receiving notes, memoranda or the like, and so arranged that the strip may be withdrawn for use from the roll by the turning of the platen roll.

SOUND REPRODUCING MACHINE.—C. W. WALLER, 2090 Washington Ave., Bronx, N. Y. The invention relates to improvements in sound reproducing machines of either the phonograph of graphophone type, and more particularly to that class of sound reproducing machines in which the sound reproducing and amplifying means are inclosed within a cabinet.

### Prime Movers and Their Accessories.

SLIDE VALVE.—J. W. MILLER, P. O. Box 91, Winchester, Ill. In the present patent the invention has reference to slide valves for engines, and the main object thereof is to provide means whereby such valves will automatically find a seat which, at the same time, positions the valve with respect to the ports.

VALVE SPRING COMPRESSOR.—J. J. EAGAN, 90 Monroe St., Brooklyn, N. Y., N. Y. This invention refers to devices for facilitating the removal of valves from the valve casings of internal combustion engines, and is more particularly designed for use in connection with the Ford engine. It provides a valve spring compressor which can be easily and quickly applied, whether to place the valve in position or to remove the same from the valve casing.

### Railways and Their Accessories.

RAILROAD SANITARY APPARATUS.—G. W. KELLEY and I. S. KELLEY, care Kelley Bros., Grand Central Terminal, New York, N. Y. This invention provides impounding means for railroad toilets, adapted to be emptied by authorized persons; provides means for heating the impounding receptacle to prevent freezing of the contents thereof; and provides a steam heating equipment for said receptacle, having an automatic drain to prevent the accumulation of water therein.

SAFETY DEVICE FOR RAILROAD TURN TABLES.—J. T. SHERIDAN, Bowling Green, Mo. The improvement provides means which will lock a turntable when it is positioned relatively to a track to receive a locomotive on the track and which will automatically dispose a stop block on one of the track rails when the turntable is unlocked to permit of the rotation of the turntable.

### Pertaining to Recreation.

FISHING DEVICE.—D. CONEKIN, care of Pilots Association, Charleston, S. C. The invention provides a construction and arrangement of means whereby fish may be automatically taken from the water and deposited in a cold storage receptacle, without the necessity of manually handling the fish and with a great saving of expense and labor. Mr. Conekin has invented another fishing device, in which he provides an arrangement whereby electric lights may be carried by the net supporting outriggers in such position as to cast their rays diagonally across the course of the vessel so as to concentrate them in advance of the net, in order that fish happening in the zone of illumination may be blinded so as not to notice the approach of net and vessel.

DOLL'S HEAD.—MARY E. RADICK, 26 Oakwood Ave., White Plains, N. Y. This doll has a plurality of faces, each having a different expression with means whereby any one of the faces may be exposed, while the others are covered so that the child can give different facial expressions to its doll, for example, either of happiness or sorrow.

### Pertaining to Vehicles.

POWER TRANSMISSION MECHANISM FOR MOTOR VEHICLES.—G. M. STONE, Griswold, Iowa. By this mechanism power transmitted from a suitable drive shaft to the power axle or shaft of a vehicle or machine may be employed so that two sections or power shafts may be driven simultaneously and at equal speeds in one direction, or in opposite directions, or whereby one of the sections may be driven while the other remains stationary, thus permitting the shaft or vehicle to be propelled forwardly or backwardly, or in the event of a vehicle turned at short angles approximately squarely around.

RESILIENT TIRE.—S. B. NEUHAUSEN, care of Alfred Doria, 229 W. 46th St., New York, N. Y. An object of this invention is the provision of a resilient shoe for automobile wheels wherein the shoe is formed with a substantially tubular body divided into sections, and the sections split so as to present resilient side members.

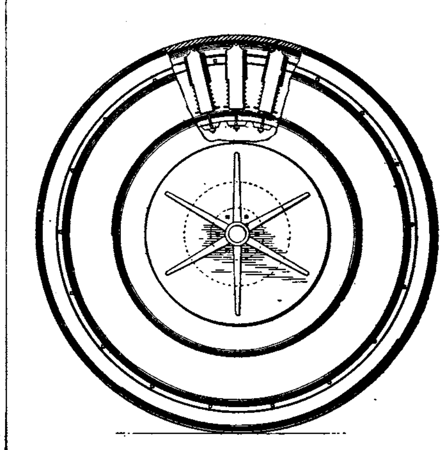
SPEED CHANGING GEAR.—E. M. RAYBURN and A. G. RAYBURN. Address E. S. Rayburn, Sausalito, Cal. This flexible device is for use in transmitting power from the power plant of the vehicle to the wheels, wherein the driven shaft is connected to the countershaft by means of a variable speed connection, and wherein the countershaft is connected to the driving shaft in such manner that the said shafts may be smoothly and gradually connected without any shock or jar.

CRIB ATTACHMENT FOR GO-CARTS.—C. S. HEATH, Montrose, Colo. This improvement provides a crib of a form attachable to and detachable from an ordinary folding go-cart of any approved form. It provides a firm leg support for the front of the crib, together with fastening means for the rear end of the crib, to detachably secure the crib body to the top frame of the cart body, at the rear.

HEADLIGHT CONTROL.—W. C. SYKES, Greensburg, Pa. An object of this invention is to provide means for projecting a light downwardly or upwardly so as to illuminate a rising or descending road in front of the vehicle, whereby the steepness of the road can be easily brought to the view of the driver of the vehicle.

WHEELBARROW.—J. H. ROYALL, Wake Forest, N. C. The purpose here is to provide a device having sides of very light material which can be brought into position or removed therefrom, and which, when removed, are still carried by the bottom portion of the device, so that there is never the necessity of hunting for sides which have been misplaced.

WHEEL.—T. C. BENBOW, Absarokee, Mont. This invention provides a resilient wheel for use with motor vehicles, such as automobiles and the like, wherein cushioning elements are arranged within a tire for cushioning jar and shock, and wherein the tire is provided with a tread member, and wherein all of the cushion-



WHEEL FOR MOTOR VEHICLES.

ing mechanism is housed in such a manner as to prevent the entrance of dust and the like, while at the same time the resiliency of the wheel is not impaired, and the wheel is not increased in size and does not differ greatly from the ordinary wheel.

HYDRAULIC TRANSMISSION.—W. B. PEPPER, Montrose, Colo. In this patent the object of the invention is the provision of a novel differential transmission unit having a hydraulic action and attaining the desired results, including a wide range of gear ratios, both forward or backward, without the use of either spur or bevel gears.

MAXIMUM PRESSURE SAFETY INFLATING TIRE GAGE.—S. P. NOE, 142 Mt. Hernon Way, Ocean Grove, N. J. The primary object of the inventor is to provide a device which will provide a certain and positive means for insuring the exact pressure in an inner tube for a pneumatic tire or the like that such tire is designed to carry, and to automatically indicate at all times the pressure within the tire and especially the maximum pressure which the tire is adapted to withstand.

COLLAPSIBLE CORE.—G. E. HORTON and C. S. WAGNER, 198 South Main St., Akron, Ohio. The collapsible core is for use in the manufacture of rubber tires; and the inventor's object is to provide a core which can be easily and quickly manipulated. This object is attained by providing a core formed of a plurality of sections bound together by means of fixed and expanding rings.

### Designs.

DESIGN FOR A VANITY CASE.—E. A. GUTHMAN, 139 W. 19th St., New York, N. Y. This vanity case is oblong in form and comprised of three sections, of which the center one holds a small circular mirror, the whole article having scalloped edges around it and across the tops of its sections.

DESIGN FOR A BUTTON, BADGE, OR SIMILAR ARTICLE.—P. R. JOLLY, 51 Maiden Lane, Raleigh, N. C., and R. L. FOWLER, New York, N. Y. This design is circular in outline and consists of a baby sitting on a floating leaf, holding a lily in its hand, the infant held by a cord grasped by the bill of a tall water bird standing on the edge of a reed bank and dressed in the garb of Uncle Sam.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

WE wish to call attention to the fact that we are in a position to render competent services in every branch of patent or trade-mark work. Our staff is composed of mechanical, electrical and chemical experts, thoroughly trained to prepare and prosecute all patent applications, irrespective of the complex nature of the subject matter involved, or of the specialized, technical, or scientific knowledge required therefor.

We also have associates throughout the world, who assist in the prosecution of patent and trade-mark applications filed in all countries foreign to the United States.

MUNN & Co.,
*Patent Solicitors,*
233 Broadway,
New York, N. Y.

Branch Office:
625 F Street, N. W.,
Washington, D. C.

## Seventy Years of Invention

*(Concluded from page 520.)*

menting. The present type of automatic bobbin-changing loom was the outgrowth of an invention made by James H. Northrop, who instead of following the old idea of changing the shuttle in order to renew the weft, conceived the idea of changing the bobbin in the shuttle automatically while the loom was in motion. By April, 1890, several looms were constructed on these lines. The basic patent for filling-changing looms was granted on June 23rd, 1891. Before this patent was issued no one had ever automatically placed filling in a shuttle in a shuttle box of a loom and threaded the shuttle automatically. On the same date, Rhoades received a patent for shuttle-changing mechanism, which applied the principle of the weft fork for detection of the absence of the failure of filling and of an ejector to the changing of a shuttle in which the filling was exhausted. These patents constitute the foundation of the monopoly possessed by the Draper Company for automatic filling-changing looms.

An early patent for automatic weft-replenishing looms, especially adapted for multi-colored weaving, was granted to Wyman and Crompton in 1898. These inventors were the first to use a loom containing a series of shuttles under the control of a pattern surface to present at a shed a shuttle having a desired different colored filling and an apparatus by which to provide such shuttles automatically with like filling, thus avoiding the stoppage of a loom when filling is to be supplied to a shuttle; also having suitable devices to move positively the filling feeder having filling of different colors, so that the filling of the desired color may be put in position to be removed from the feeder and put into a shuttle then in place to receive it.

### 1905-1915

The nearer we come to the present day the more difficult it is to pick out the inventions of importance. It is impossible to tell at the birth of an idea what its future development may be. And so in listing the inventions of 1905 to 1915, we shall undoubtedly leave out many inventions that may prove of highest consequence in years to come, and, on the other hand, we may include some that loom up rather large now, but which when viewed from the proper perspective of time, may prove to be not so important after all.

Many of the recent inventions are referred to in detail in the special articles in this issue, and to avoid repetition they will not be listed here, which will account for the rather meager showing of the following list.

**Paper Pulp Improvements.**

In the paper pulp industry the past ten years have been marked by important developments: The rate and uniformity of production have been increased especially by the use of tall magazine grinders, introduced from Germany within the past three years. Grinders of the magazine type hold twelve cords of wood, which are sufficient to keep the stone engaged for a twelve-hour grinding period. The supply of stone to the grinder box is regulated automatically by hydraulic presses operating on each side of the stone, so that the grinding operation may be continued during an entire night shift without attention.

In the United States the development of the paper industry to its present proportions has taken place very rapidly. The Fourdrinier parts have been lengthened and widened until to-day paper machines are actually in operation which have a width of 202 inches and are capable of being speeded up to 700 feet a minute, as against 90 inches of width and 200 feet a minute not so many years ago. In Germany, prior to the outbreak of war newsprint machines had been contracted for to run at a speed of 1,000 feet a minute, each being equipped with wires of 204¼ inches maximum width. The introduction of scientific methods and management in the paper industry has resulted in reducing the cost of paper notwithstanding the rising prices of raw materials. In 1879 the average price of all paper was $122 per ton, and in 1909 the cost per ton to the consumer was $56.

**High-speed Printing.**

After Campell, Tucker and Crowell had brought the newspaper printing press to a point were 24,000 to 29,000 copies could be printed an hour, no marked improvement was made until Henry Wise Wood introduced radically new ideas. One of his first presses was installed in the offices of the New York *Herald* this year. Instead of drawing the paper through the press—a proceeding which subjected it to strain and reduced the speed of printing for fear of breakage—Wood carried it along bodily without strain to the printing types. The machine adjusts itself automatically to the peculiarities of the various paper rolls, so that breakages are avoided and the amount of attention required by the press is reduced to a minimum. The paper is handled in streams and assembled in a single stream made up of as many thicknesses as the newspaper to be printed has leaves. This combined stream is then folded, cut and delivered. The rate of printing is 60,000 an hour (eighteen to thirty-two pages.)

Although inventors had given the newspaper office the rapid printing press and type casting and composing machines, stereotyping remained almost at its starting point, one of the few arts still in the realm of hand labor. In 1900 stereotyping was revolutionized by the introduction of Henry Wise Wood's "Autoplate" machine. This consists of a casting mechanism and a series of finishing mechanisms which automatically co-operate in one machine to make casts and finish them. When used to make plates of the conventional half-inch thickness its speed is four finished plates a minute; but when the thickness is but one quarter of an inch eight plates a minute are easily obtained. A single machine does work that could not be so well performed by thirty-five men.

**The Gyroscope.**

One of the promising developments of the decade, but whose importance it is impossible to gage thus far has been the use of the gyroscope in a great many widely different applications. Mr. Louis Brennan, inventor of the Brennan torpedo, devised a gyroscopic monorail, the car being supported on the rail without any lateral guides, by the action of a pair of oppositely turning gyroscopes. This renewed interest in the previous invention of Schlick, who used a gyroscope to keep a ship from rocking. Dr. H. Anschütz-Kämpfe developed a gyroscopic compass to displace the magnetic compass, and this has been used with considerable success in warships, particularly submarines in which the compass is entirely surrounded by a steel shell that acts as a shield for the magnetic needle and prevents it from being affected by the earth's magnetism. A gyroscopic stabilizer for aeroplanes was developed by Sperry in this country.

**Metalizing or Metal Plating.**

A process of dry galvanizing or "sherardizing" was discovered by Mr. Sherard Cowper-Coles. By this process iron and zinc can be coated with metallic zinc by the simple operation of bedding the piece in zinc dust in a drum and raising the temperature of the zinc dust to 500 or 600 deg. Fahr., which is some 200 degrees below the melting point of zinc. Dr. Schoop of Zürich invented a method of coating objects with metal in which the metal in pulverized state was projected against the object by a jet of high-pressure steam. The object is thus bombarded with a hail of fine metallic particles, which are liquefied by the energy of the impact, and thus soldered one to another.

In 1907 E. G. Acheson discovered a method of producing defiocculated graphite.

**Mechanical Engineering.**

There were many improvements in mechanical engineering aside from those listed in our article on machine tools. Mr. H. A. Humphrey, a well-known English engineer, invented an internal combustion water pump. In this pump there are no moving parts except the mushroom valves. The explosive mixture of gas and air is ignited in the engine in contact with one

end of a column of water which fulfills the dual function of piston and flywheel and moves so as to draw in a fresh combustible charge, to compress this charge previous to explosion, to permit expansion to be carried on to atmospheric pressure, and finally to exhaust the products of combustion. All these movements are brought about and controlled by changes in the momentum which occur naturally in the column of water itself.

Nikola Tesla invented a steam turbine, which depends for its operation on the viscosity of steam, acting upon a series of flat metal disks narrowly spaced apart.

Charles M. Manly, who first sprang into prominence in connection with his work on the Langley aeroplane, developed a hydraulic drive system that is a hydraulic means of controlling the speed of a motor vehicle. A number of similar variable speed gears were developed, one of them being used with great success for elevating or "pointing" the guns of battleships.

Mr. David Roberts invented the caterpillar tractor which could haul heavy guns or other trailers over rough country. The creeping action of the caterpillar tractor enables it to go over country that is cut up by gullies and over sandy or marshy ground with equal facility.

The decade was particularly marked for developments in illumination, but this subject is fully covered in a special article.

In 1906 Hans Kuzel succeeded in making filaments from the colloids of heavy refractory metals such as tungsten, vanadium, etc. The filaments thus obtained when heated pass over to the metallic state and form very thin homogeneous threads of pure metal. Efficiencies of one watt were obtained.

The rise of the moving picture industry made it important to obtain a safe film. In 1907 A. Eichengrün conducted experiments with Becker and Guntrum, which yielded acetyl-cellulose, known better by the trade name of cellite. Cellite is not generally used as a material for photographic films, but rather as a transparent substitute for celluloid for other industrial purposes.

The commercial development of the phonograph in the past ten years has been almost as remarkable as that of the moving picture industry.

Early in the decade Parsons of turbine fame brought out his "auxetophone," a device for augmenting talking machine sound reproduction by the use of compressed air, the air being admitted through a valve controlled by the needle, and hence taking the place of the reproducing diaphragm.

In this decade, Thomas A. Edison completed his storage battery in which nickel hydrate forms the active material of the positive plate, and iron oxide of the negative plate, while the electrolyte consists of a solution of pure potassium hydrate (caustic potash) in distilled water.

Fournier d'Albe invented an apparatus known as the "optophone," which renders light audible. This effect is accomplished by the use of selenium cells in an electric circuit, containing a telephone. By its use a person totally blind may be able to locate a window or open bright light, and to discover readily the shadows of objects passing between him and the light.

## The Rise of the Automobile

(*Concluded from page 522.*)

everything before them. In the rear of the crowd of contestants was Frank Duryea with his American machine. No one had any idea that it would figure prominently in the race. For a long time Frank Duryea was retarded by having to thread his way through the slower machines. One fifth of the distance had been traversed before he cleared the crowd. Then he put on full speed. One after the other he passed the fast foreign cars, and when he reached Brighton he sat down and waited nearly an hour for his nearest competitor to come up. America led the world! But, as Mr. Charles E. Duryea has tersely put it, "Americans were not ready for the automobile. Oats too cheap."

We must turn back now for a moment and look into the early history of the electric vehicle. It antedates the gasoline vehicle, for in 1882 we find, in Boston, an electric "brake" with a capacity for eight passengers. This ran at a maximum of 16 miles per hour and at half that speed could make 40 to 50 miles on a single charge of the battery. In 1888 P. W. Pratt was running an electric runabout on the streets of Boston. The idea of an electrically propelled vehicle occurred to inventors long before this, but it was not until about that time that the storage battery had developed to an extent that made it available for pleasure purposes. In 1896 an automobile race was held at the State Fair at Providence, R. I. A Duryea gasoline car maintained the lead, but an electric car built by A. L. Riker followed it closely and was beaten out for second place at the finish by another electric car entered by the Electric Carriage and Motor Company. The next year the Pope Manufacturing Company built a two-seated phaeton, driven by electricity, and in 1898 the manufacture of electric vehicles had assumed such proportions as to make a very creditable showing at the Electrical Show held in Madison Square Garden, New York.

Returning again to the gasoline vehicle, we find Alexander Winton a most active promoter of public interest in the automobile. As early as 1897 he started out on a long-distance tour, attempting to run from Cleveland to New York city. The difficulties of such a trip can only be realized when we consider that the roads in those days were far worse than they are now and the motorcar was by no means a robust machine. It took Winton from June 28th to August 27th to complete the trip. In 1901 Winton tried another very ambitious tour, this time a transcontinental tour. After encountering almost insuperable difficulties, his tour finally ended in the sands of the great desert through which he found it impossible to make his way. In 1903 Winton succeeded in driving across the continent. Two other machines also made the trip, namely, a Packard and an Oldsmobile. The first beginning of automobile manufacture is claimed by Winton, who in 1898 built and sold four motorcars.

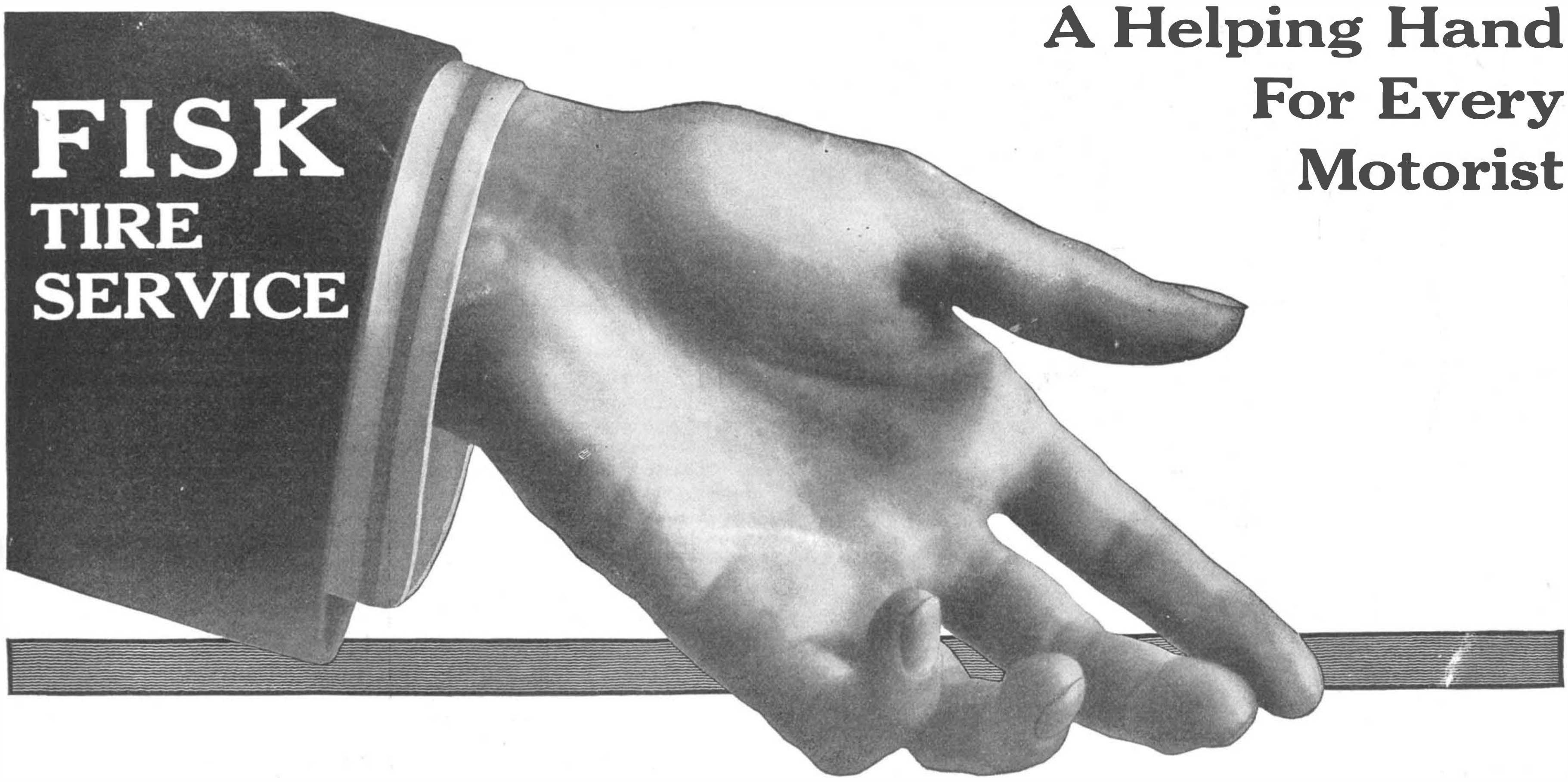
The first automobile show in New York was held in 1899. This was really a bicycle show, in which automobiles were included as a prominent feature. The next year the automobile had a show all to itself, and among the features of domestic manufacture were many steam machines and several electrics.

Track racing suddenly became very popular. A notable contest was held at the mile track at Guttenberg, N. J., in 1900, where races were held between gasoline, electric, and steam vehicles. One of our photographs shows the start of a five-mile race between two Panhard and Levassor machines, which was won by A. C. Bostwick in the remarkable time of 7 minutes and 43⅕ seconds, a speed of close to 38 miles per hour. In the ten-mile championship race the same two cars raced, but this time they had a serious competitor in an electric racing car built by A. L. Riker. In these days we are not accustomed to class electrics as racing automobiles, but in that race the Riker machine romped away from the others and led them by many yards at the first mile, when unfortunately, a short-circuit disabled the batteries and put the machine out of the running. Bostwick again won the race. His time was 15 minutes and 9⅘ seconds, a speed of between 39 and 40 miles per hour. It is interesting to note that, despite his early successes, Mr. Riker abandoned the electric and became chief engineer of the Locomobile Company, which originally built steam cars and finally abandoned steam for gasoline.

An omnibus provided with gasoline electric drive was exhibited in 1902. In the Automobile Show of 1903 the air-cooled four-cylinder Franklin was a prominent feature. Public demand for a light, inexpensive car was reflected in the motor-driven buckboard. At the show in Paris that year the beehive radiator made its appearance, also magneto ignition.

In 1904 the American automobile had developed so far that the SCIENTIFIC

## A Helping Hand For Every Motorist




# This Is To Be Taken Literally And Interests Every Car Owner!

SO FAR as we can, through our Service System, we will eliminate for *any* car owner all inconveniences in the use of tires.

If you use tires other than Fisk, we particularly invite you to stop in at one of our Branches the next time your tires need attention and thereby inform yourself as to the *substantial* qualities of Fisk Service. To present Fisk Users we would say that the privileges enjoyed at your local Fisk Branch are to be found in every city where we are located.

The Secret of the Success of the Fisk Service Policy is its uniformity. The Service is organized. There is nothing like it in the tire industry. We are building our business on an Established Reputation for Good Tires and for Courtesy and a Personal Interest in the requirements of *all* tire users.

*Tourists should send for a list of Fisk Branch Addresses and Plan to take advantage of our Service even though they may not use Fisk Tires.*

Every car owner, regardless of what tire he may use, is *welcome* in any Fisk Branch. He will find there a spirit of accommodation which will add materially to his pleasure and convenience when his tires are in need of attention of any kind.

Time to Re-tire?
(Buy Fisk)

## Fisk Tires Are An Extraordinary Buy

Prices are Low. There never was a time when Fisk Tires were better quality or gave more universal satisfaction. This statement can be easily verified by inquiry among Fisk Tire users.

## THE FISK RUBBER COMPANY

**Factory and Home Office** **Chicopee Falls, Mass.**

*You Can Buy Fisk Tires From ALL Dealers—Fisk Branches in ALL Principal Cities*

AMERICAN felt justified in declaring that "we have caught up with France, or at any rate, are close to her heels." The Automobile Show that year was very elaborate. The honeycomb radiator had pretty well disposed of the finned tube and was now well established. More attention was paid to automobile tops which would render the cars serviceable in bad weather. The motor was universally placed in front, where it could get air. The air-cooled motor with a fan proved a success. The transmission and rear axles were provided with ball bearings. The mechanism was provided with mechanical lubrication. Carbureters were rendered automatic. The use of the magneto was on the increase, although most of the cars still used dry batteries. Wheel steering became almost universal. Several two-cycle three-cylinder cars appeared. Wood was replacing wire for wheel spokes. Altogether the cars were beginning to approach present standards.

In 1905 people began to realize that they need not store their cars away for the winter, but could use them in heavy snows. The four-cylinder car was well established, and bevel drive displaced the chain almost entirely. The old bicycle wheel tubing disappeared and special girder construction was used in the framework of the chassis. Special grades of steel were introduced. The coach builders became active in improving the design of the car bodies. The jump spark was used almost entirely and the sliding transmission was extensively employed. In 1906 the multiple disk clutch came into prominence, and roller bearings on the rear axles began to be used. A great deal of attention was then paid to shock absorbers and rebound checking devices. The machines were provided with expanding foot-brakes and emergency band-brakes. In 1907 the six-cylinder engine began to appear. Low-tension ignition and also the chain drive were fast dying.

For the next few years there were no startling changes in the automobile, but the body design was greatly improved. The low-priced car made its appearance in 1909, and in 1910 we have the bloc cylinder casting and a common use of left-hand drive. The next year the Knight silent engine, an American invention, which had been taken abroad a few years before because it found little encouragement here, was brought back again from England, where it had met with great favor, and was introduced in American cars. This focused attention upon noise in the common engine, and means were used for quieting even the poppet type of engine.

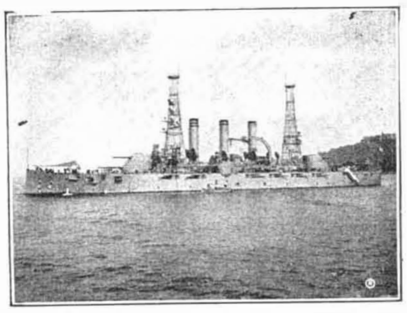
By 1912 the fuel problem had become so serious owing to the introduction of inferior grades of gasoline to meet the enormous demands of motor users, that mechanical means of starting the engine became absolutely imperative. Suddenly a great many self-starters appeared—some electric, some pneumatic, some operated by an explosive charge, and some by a mechanical spring. The following two years were marked by an increasing use of electricity in gasoline-driven machines, for starting engines, shifting gears, operating horns, lighting the car, and so forth. An attempt was made to introduce the cyclecar into this country, but so far the American public has not taken very kindly to this type of machine.

This brings us down to the present year, in which the chief development is the multi-cylinder engine. The Cadillac Motor Car Company started the movement last fall with an eight-cylinder V-type engine, which is proving so popular that a number of other manufacturers have introduced the eight-cylinder engine or are planning to do so in the immediate future; and now, just as we are going to press, comes the announcement of the Packard Motor Car Company of a twelve-cylinder car or twin six.

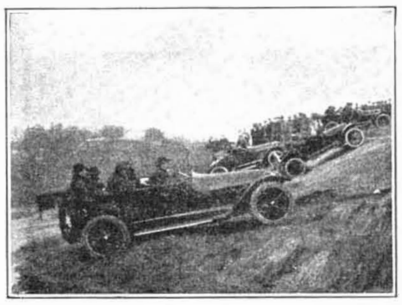
Such, in brief, is the history of one of the most remarkable industrial developments the world has ever seen, an industry which in less than twenty years has grown to be one of the most important in the country. Its influence has been felt in a score of other industries. The pres-

# The Wide Use of the Storage Battery

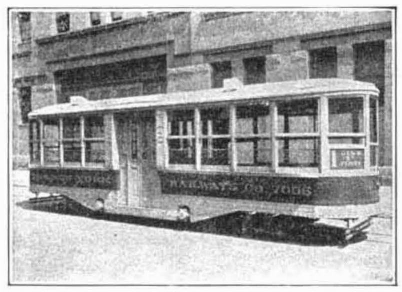
## A Story of Unusual Achievement



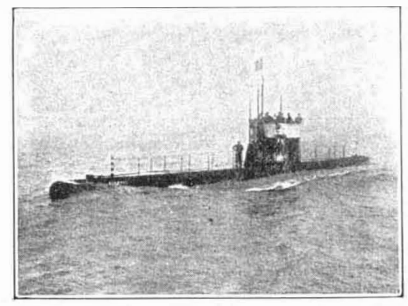
The "Exide" Battery is very widely used both on sea and land for firing large guns.



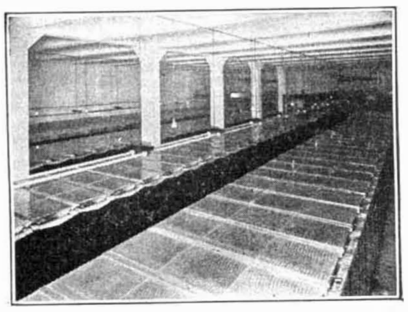
Over 250,000 automobiles are equipped with the "Exide" Battery for starting, lighting and ignition.



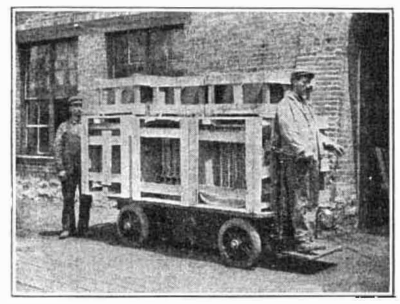
174 of the storage battery street cars in New York City are operated by "Hycap-Exide" Batteries.



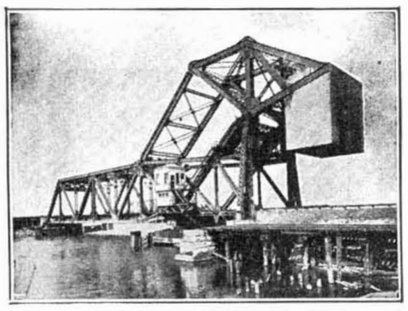
A large majority of the Submarines in the U. S. Navy use "Exide" Batteries for their operation when submerged.



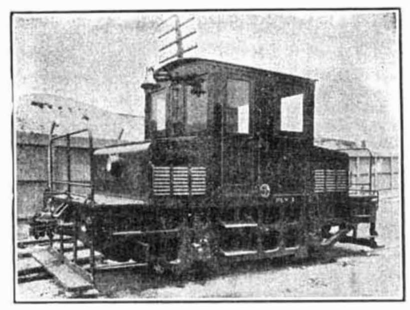
"Exide" Stand-By Batteries are used by the large Electric Lighting and Power Companies to assure their customers of uninterrupted service.



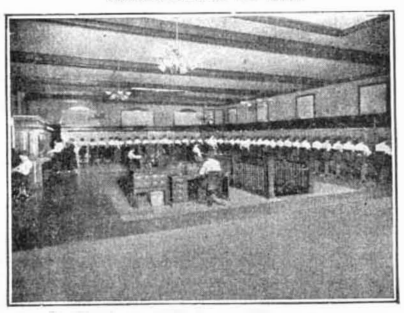
Industrial trucks, operated by "Ironclad-Exide" Batteries are found to be efficient and economical.



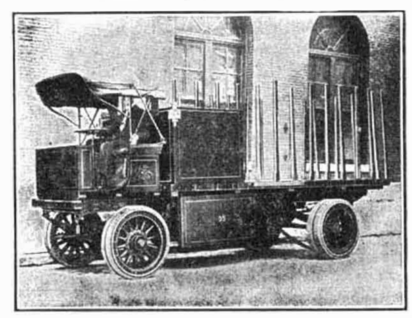
The "Chloride Accumulator" is widely used in connection with electrically operated draw-bridges.



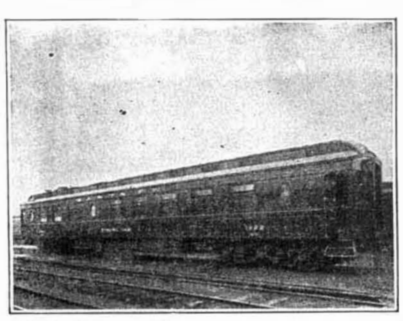
"Exide" and "Ironclad-Exide" Batteries are very widely used in industrial and mine locomotives.



The Bell, Western Union and Postal Companies depend upon the "Chloride Accumulator" for telephone and telegraph service.



The four famous "Exide" Batteries have for years been used in a large majority of all electric vehicles manufactured.



The "Chloride Accumulator" and the "Tudor Accumulator" are very widely used for car lighting.

The dependability of the "Exide" Battery is strongly evidenced by its use in aeroplanes.

DID YOU SAY you were not interested in storage batteries? Do you realize that not a day passes that a storage battery is not called upon to do some work for you? Look at the illustrations on this page. Did you know that storage batteries were a vital factor in all these applications of electricity?

How much use could be made of water if there were no tanks, pails, buckets, etc., to hold it? A storage battery is to electricity what a receptacle is to water.

In this country "storage battery" and "The Electric Storage Battery Company" are inseparably associated. You can't think of one without thinking of the other, because for 27 years this company has produced by far the greatest part of all the storage batteries manufactured in this country.

Just consider this thought. If all the storage batteries made by The Electric Storage Battery Company were suddenly thrown out of service this whole country would be badly crippled. Think of conditions with the millions of Bell telephones out of service. Think of the electric lighting companies in New York, Chicago, Philadelphia, Boston and other large cities without a reserve supply of electricity in cases of emergency. Think of many of the railroads without signal apparatus with which to operate their trains. Think of submarines in the United States Navy without batteries for their operation when submerged. Think of thousands of electric delivery wagons and trucks suddenly made useless. Think of hundreds of thousands of automobiles without batteries for starting, lighting or ignition.

And again, don't get the idea that a storage battery is merely a wood or rubber receptacle containing plates of lead immersed in dilute sulphuric acid.

The big jobs and the imporant ones that storage batteries are doing every hour of the day prove that storage battery design and manufacture is of necessity a highly specialized and developed art. Storage batteries are and have been a most important factor in the growth and development of the electrical industry.

This Company, organized in 1888, is the oldest, the largest and the most experienced storage battery manufacturer in this country. The trade-marked names "Exide" and "Chloride Accumulator" are without doubt the most valuable storage battery trade marks in the country.

Electrical engineers throughout the country know from long experience that these names stand for scientific design and the highest quality of material.

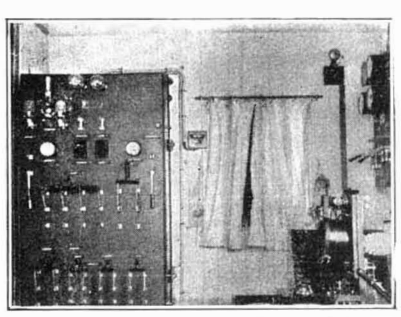
Although the demands for new types of storage batteries have developed so rapidly, yet this Company has always thoroughly tested under actual service conditions each new design of its batteries before allowing it to be put on the market. It has not experimented on its customers. The reputation of the Company has been very carefully built up and maintained from year to year.

And beside designing and manufacturing storage batteries which have given the Company the leading position in the industry, it has also built up a large service organization so as to most efficiently serve its customers in all parts of the country. This organization includes 15 Sales Offices, 13 Battery Depots, Branch Construction and Operating Departments and over 1000 Distributors. No battery user is far from a reliable source of information.

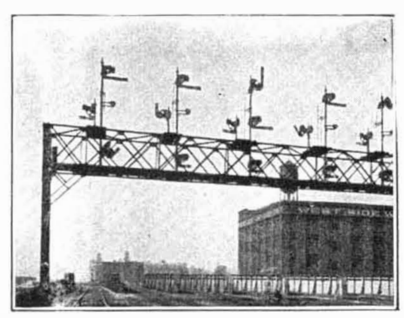
If you are interested in storage batteries, whether a small battery for your motor car or a large battery for your local electric lighting company, you can with the utmost confidence take up the matter with this Company.

Engineering co-operation, battery instructions, descriptive literature covering batteries for any particular service—all are at your disposal. Write our office nearest you.

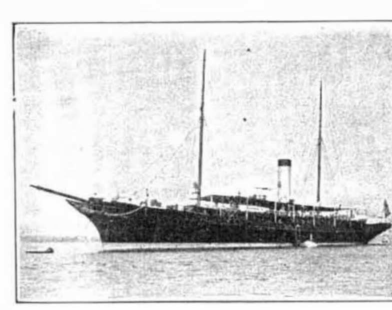
The "Hyray-Exide" Battery has made it possible for every farm to have its own electric lighting plant.



The "Chloride Accumulator" and the "Exide" Battery have been made standard for wireless service.



The "Chloride Accumulator" "Tudor Accumulator" and "Exide" Battery give the reliable source of energy necessary for railway interlocking switch and signal work.



Hundreds of yachts are equipped with the "Chloride Accumulator" or "Exide" Battery for electric lighting service.

# THE ELECTRIC STORAGE BATTERY CO.

New York Boston Chicago Washington **PHILADELPHIA, PA.** Denver San Francisco Seattle St. Louis
Cleveland Atlanta Pittsburgh Detroit **1888-1915** Rochester Los Angeles Toronto

ent high development of American machine tools is directly traceable to the automobile. American automobiles invaded European markets even in time of peace and proved to be a serious competitor, especially the lower-priced cars, and now our motor trucks are pouring into war-torn Europe.

A report just issued by the United States Department of Agriculture on the motor vehicle registrations and revenues for 1914, shows that we have 1,660,984 automobiles in service and 44,355 motor trucks. There are 21,255 manufacturers' and dealers' licenses and 427,179 owners' and chauffeurs' licenses.

### Transportation on Land and Sea

*(Concluded from page 526.)*

Considerably over a billion passengers have been carried on this system, through a continuous stretch of years, without the loss of a single life.

#### Development of the Steam and the Electric Locomotive.

The purpose of the present article is to trace the principal improvements in the steam locomotive during the past seventy years, and follow this with a brief account of what has been done in applying electrification to steam railroads.

Beginning with the year 1845, we note that the locomotive engine had then reached a high degree of efficiency, but was still far from being an economical power plant. We shall, therefore, find that during the period under notice the efforts of engineers were to make the locomotive more efficient by increasing its hauling capacity and reducing the cost of fuel and maintenance. Progress has thus been attained by studying the details of feed-water heating, more or less perfect combustion, variable steam cut-off, compounding, superheating, and mechanical stoking; for, as life is made up of details, so is the locomotive engine.

Fig. 1 shows a typical locomotive of seventy years ago. It was a wood-burning Rogers engine weighing about 18 tons and was built for the Morris & Essex Railroad, now a part of the Lackawanna Railroad system. It had a peculiar double valve gear with independent cut-off, by which the lap of the valves could be varied at will, with the object of economizing steam; but the design was soon abandoned and the Stephenson link motion was adopted. For about fifty years this valve gear was in general use, but the increasing size of the engines involved a proportionate increase in the weight of the double eccentrics and heavy links, so that at high speeds the friction and resistance were enormous. A further objection was that the link connecting the two eccentrics, moving through wide angles, caused the block to slip in the link, producing distorted and lost motions. For these and other reasons, it has ceased to become a desirable valve gear.

About fifteen years ago the Walschaerts gear came into use in the United States. This motion, while retaining the link, dispensed with one eccentric, and could be placed outside the frames, giving easy access to the parts. Also, the link being pivoted to a fixed center, there is not so much slip and lost motion as in the Stephenson gear. An exhaustive article on this valve motion will be found in the SCIENTIFIC AMERICAN SUPPLEMENT of March 27th, 1909.

In recent years some improved valve gears have been introduced to still further remedy the evils of radial motion. Two examples are illustrated herewith. Fig. 5 shows the Baker valve motion, which dispenses with links and sliding blocks, and substitutes a bell crank lever, a radius bar and a yoke. The movement is derived from the cross-head and the eccentric crank. The cross-head moves the valve the amount of the lap and lead each way, and the eccentric crank gives the remainder of the movement. The operation gives a quick opening of the port by the valve, and an increased pre-admission as the cut-off is shortened—a great advantage in high speeds.

Fig. 4 illustrates the Southern locomotive valve gear. In this design there is a link, but it is bolted rigidly to the engine frame and is stationary. There is thus no slip of the block, as it only moves in the link when the reversing lever is shifted to vary the cut-off or reverse the engine. Cross-head connections are eliminated, the valve movement being derived from the eccentric rod and a bell crank. This motion also gives a quick port opening by the valve. These new valve gears have merit, and are coming into extensive use.

Economy of fuel and water have been studied by the leading engineers of the world, among them being Joseph Beattie, late locomotive superintendent of the London & Southwestern Railway (England). In 1856 he built a remarkable locomotive, which is illustrated in Fig. 3. This engine weighed about 25 tons and hauled some of the fastest express trains at that time. The upright cylinder in front of the smokestack was a feed-water heater, through which the exhaust steam was passed, where it came in contact with water from a circulating pump. This water was thus heated to near the boiling point, and what was not immediately required for the boiler feed was forced back, along with the condensed steam, into the tender, heating the water there. A portion of this water was intercepted by the boiler feed pump and forced through a surcharging chamber in the smoke box, which raised its temperature above the boiling point before it entered the boiler. The fire box was divided transversely into two compartments by an inclined water space, each compartment having its own fire door, grate, and ash pan. The rear, and larger, compartment was arched with perforated tiles, and a combustion chamber in the boiler was nearly filled with perforated fire bricks. The gases from the rear furnace thus passed through the tile bridge, over the hot fire in the front furnace, and there ignited, passing through the bricks in the combustion chamber, and thence through the flues. The writer has seen these engines at work. They burned bituminous coal and consumed their smoke perfectly, showing a fuel economy of over 15 per cent.

During the period under notice, much attention was given to balancing the reciprocating parts of locomotives. Many designs were brought out, but only one can be noticed here, and is illustrated in Fig. 2. This was a four-cylinder balanced engine, the cranks being oppositely disposed. It was designed by John Haswell, a British engineer, and was built in 1861 for the Austrian State Railways. This engine weighed about 34 tons and ran with remarkable steadiness. Although it was a simple engine, it was the precursor of the modern four-cylinder balanced locomotive; but before this latter engine came into the field, a number of two- and three-cylinder compound engines were tried. These were efficient until the time came when the great size of the low-pressure cylinders made them too large for the clearance limits of platforms, bridges, and tunnels. Four-cylinder compounds, with all the cylinders outside the frames, were subject to the same limits; and so, about fifteen years ago, this class of engine, having a different arrangement of cylinders, came into use. A notable example of this design is a French express locomotive, which began service on the Chemin de Fer du Nord five years ago. It hauls some of the fastest trains in the world and, with the tender, weighs 158½ tons. The cranks are balanced, with the high-pressure cylinders outside and the low-pressure cylinders inside the frames. The steam is superheated and the fuel is fed by a mechanical stoker. This fine engine was illustrated in the SCIENTIFIC AMERICAN of December 16th, 1911.

Another class of compound locomotive has all the cylinders outside the frames. This system is a feature of the Mallet engine, which came in about the year 1888. The latest example is illustrated in Fig. 7, which shows the heaviest and most powerful locomotive in the world. It has three pairs of cylinders, one pair being under the tender. The total weight of the engine and the tender is 426½ tons. This locomotive is working on the Erie Rail-

road and was fully described in the SCIENTIFIC AMERICAN of June 13th, 1914. It has a feed-water heater, a fire brick arch, a superheater, and a mechanical stoker. These last two improvements have done more than any others to increase the efficiency and output of the steam locomotive, thereby helping it to retain its place in successful competition with the electric motor. By superheating the steam, cylinder condensation is reduced, and the increased volume of superheated steam results in more work being performed with the same quantity of water. Superheating is not new. About the year 1859 some British-built locomotives worked successfully with smoke-box superheaters.

In the matter of coal consumption, when we consider that the fireman of a modern locomotive has to shovel coal into the fire box at the rate of about 6,000 pounds an hour, or 100 pounds per minute, it is evident that on the largest locomotives hand firing is impractical. The Erie engine (Fig. 7) is equipped with a Street mechanical stoker, which is illustrated in Fig. 6. It consists essentially of a screw conveyor for passing coal from the tender to the locomotive, an elevator for raising it to a point above the fire door, a system for regulating its delivery to the fire box, and a distributing system for spreading it over the grate. Over six hundred of these stokers are now in successful use, increasing the earning power of the locomotive from 10 to 20 per cent.

In the year ended June 30th, 1914, the steam railways of the United States spent over $250,000,000 for locomotive fuel; and the cost of fuel is increasing. Experiments conducted during the past year have demonstrated that pulverized coal is the coming fuel; for, even with low grades of coal—now considered useless—practically perfect cumbustion with absence of smoke has thus been obtained. This new system should open the way for a marked reduction in expenditures for fuel on railways.

### Electrifying Steam Railroads.

It was inevitable, in view of the success of the trolley car, that electric traction should ultimately be applied to steam railroads. The first main line steam railroad in this country to make use of electric traction was the Baltimore & Ohio Railroad, which as far back as 1895 built some powerful 100-ton electric locomotives for hauling its trains through the Belt Line tunnel at Baltimore. Following this came the electrification of the Valtellina line in Italy. By far the most ambitious attempt, at the time it was inaugurated, to apply electric traction on a large scale to a great railroad system was the electrification of the terminal and suburban lines on two of the most important railroads in America, namely, the New York Central and the New York, New Haven & Hartford Railroads. Each of these is a four-track road and each handles an extremely heavy service. Both installations were forced upon the companies by legislative action—the result of a serious collision in the tunnel leading into the Grand Central Terminal Station, New York. The New York Central road is operated on the direct-current system, and that of the New Haven Railroad by the alternating system. The New York Central zone covers 52.5 miles of road, 255 miles of track, and employs 63 locomotives. The New York, New Haxen & Hartford Company has over 100 miles of road electrified, 606 miles of track, inclusive of yards and sidings, the system being operated by 100 electric locomotives. The progress of the electrification of steam roads throughout the world is shown in the table from a bulletin of the United States Census Bureau of 1912, which is published herewith. The latest direct-current locomotive used on the New York Central in express passenger service, which is an improvement upon the one shown in our illustration, has a speed of 60 miles an hour, drawing a 1,200-ton train. The complete weight of the locomotive is 132 tons, the drawbar pull is 66,000 pounds. The working conductor is a special type of under-running third rail.

STEAM RAILROAD ELECTRIFICATION.*

*Principal Main Line Electrification in Service.*

| Name of Railroad. | Miles of Road. | Miles of Track. | No. of Loco. |
|---|---|---|---|
| New York, New Haven & Hartford | 88 | 500 | 100 |
| Spokane & Inland Empire | 168 | 187 | 12 |
| Butte, Anaconda & Pacific | 27 | 90 | 17 |
| French Southern | 165 | 205 | 16 |
| Baden State | 10 | 31 | 34 |
| Prussian State | 19 | 50 | 13 |
| Italian State | 104 | 156 | 84 |
| St. Polten-Mariazell | 63 | 68 | 14 |
| Ratische Mountain | 46 | 48 | 11 |
| Bernese Alps | 52 | 55 | 16 |
| *Principal Terminal or Passenger Service Electrifications in Service.* | | | |
| New York Central | 50 | 240 | 47 |
| Pennsylvania | 15 | 72 | 35 |
| Long Island | 100 | 250 | .. |
| West Jersey & Seashore | 75 | 150 | .. |
| New York, Westchester & Boston | 19 | 63 | .. |
| Southern Pacific | 50 | 100 | .. |
| Metropolitan Railway, London. | 35 | 70 | 20 |
| London, Brighton & South Coast | 60 | 160 | .. |
| Paris-Orleans | 14 | 46 | 11 |
| Hamburg Ohlsdorf | 17 | 41 | .. |
| *Main Line Electrification to be Completed in 1914 and 1915.* | | | |
| Norfolk & Western | 30 | 85 | 25 |
| Pennsylvania | 20 | 90 | .. |
| Canadian Pacific | 30 | 43 | 4 |
| Chicago, Milwaukee & Puget Sound | 113 | 168 | 14 |
| Northeastern, England | 18 | 44 | 10 |
| Swiss Federal | 93 | 100 | 20 |
| Swedish State | 80 | 93 | 13 |
| Prussian State | 81 | 124 | 44 |
| Vienna Pressburg | 42 | 50 | 16 |
| Italian State | 32 | 60 | 8 |

* U. S. Census of 1912.

The electrification of the New York, New Haven & Hartford Railroad has been completed through to New Haven, covering a distance, including the New York Central Line, Woodlawn to New York, of about 75 miles. The passenger service is operated by means of 100-ton locomotives, which are rated at 1,000 continuous horsepower each. For light trains a single locomotive is used, and two for through heavy express trains, which, together, in hauling such a train at 60 miles per hour, develop on level track about 1,500 horse-power. Alternating 13,500-volt current is developed and transmitted through an overhead line. This line has also in operation a very successful freight service, the engine of which weighs 110 tons, and is capable of developing momentarily a tractive effort of 40,000 pounds and a continuous effort of 12,000 pounds. These are geared locomotives of 1,400 horse-power each, designed to haul a load of 1,500 tons in through service at 35 miles an hour. Two of these locomotives coupled up can take care of a trailing tonnage averaging from 2,500 to 3,000 tons.

Thus far no comparative figures of cost of operation have been published by which to judge of the relative economic efficiency of the direct and alternating systems as thus indicated for steam road electrification. The prevailing opinion is that the direct current is preferable for terminal and suburban service and the alternating current system for long-distance work. The raising of the voltage in direct-current service, however, has made the latter a strong competitor of the alternating current in long-distance through service.

### Seventy Years of Civil Engineering

(*Concluded from page 529.*)

Bristol, England, is a motto in Latin, which translated would read, "It is difficult to build a highway through the air." In another chapter of this issue we show how the subsequent development of the steel industry made it possible to build highways through the air on a scale of magnitude undreamed of by our fathers. There is a limit, however, to the length of bridges, or at least to the length of the individual span in bridges, and this was realized when it came to the question of providing direct unbroken railroad communication with New York city. Plans were drawn for a vast suspension bridge with a span of 3,200 feet between towers, and the western railroads centering in Jersey City, headed by the Pennsylvania, were discussing the advisability of building this bridge when the development of electric

traction, with its absence of smoke, steam and cinders, pointed to a new way of solving the problem, namely, by electrically-operated tunnels. The bridge was discarded, at least for the time being, and the Pennsylvania Railroad built two main line tunnels under the North River and the Hudson & Manhattan Railway Company burrowed beneath the same great waterway with its four separate tunnels. The Pennsylvania crossed the East River with four tunnels and the New York subway drove beneath the same river with its two tubes connecting its system with Brooklyn.

If these great works were rendered operatively successful by the development of electric traction, they were rendered constructionally possible by the development, many a decade before this, of an ingenious excavating device known as the Greathead shield, the credit for the development of which should be divided among several inventors.

The fundamental difficulty in driving a tunnel beneath an estuary or river, and therefore through material which is more or less fluid, lies in the fact that means must be taken for preventing the inflow of the material to the heading of the tunnel while it is open for excavation work. The use of pneumatic pressure, together with a shield of the general cross-section of the tunnel provided with a cutting edge, solved the problem. Credit for the inception of this method goes to that many-sided and brilliant French-English engineer, Sir M. I. Brunel. He secured his first patent for a tunneling shield in subaqueous material in 1818 and used it in building the first tunnel under the Thames River, London. Brunel's shield was rectangular; but in 1865 Peter W. Barlow, an English engineer, patented in England a method which employed a circular shield with a cast-iron lining of the completed tunnel back of the shield. Four years later he was associated with another English engineer, James Henry Greathead, in building a tunnel under the Tower of London, 1,350 feet long and 7 feet in diameter, which was completed in less than a year, a remarkable record at that time for work of this character. In 1869 Alfred Ely Beach patented a method of using hydraulic rams abutting against the lining of the completed tunnel for pushing the shield forward into the undisturbed material. A later and most important development of subaqueous work was that used in the completion of the downtown tunnels of the Hudson Terminal tubes. This was the displacement method by which, instead of permitting the material to enter the tube through the shield for removal through its approaches, the shield was pushed bodily forward, the fluid material flowing around the tube as it progressed.

The general public is so thoroughly familiar with the engineering features of the subway work which is being carried on in its midst that it calls for no detailed description here. The excavation is now usually done by cut-and-cover work, in which the street pavement is replaced by timber roofing supported on heavy timbering, over which the street traffic passes while the work of excavation is carried on below. In the earlier subways, the roof was supported on steel columns and steel floor beams, arches being thrown in between the floor beams. The latest method is to make the tunnel lining of monolithic reinforced concrete—a cheaper and more rapid method of construction.

### Foundation Work and the "Skyscraper."

The method of building deep foundations in loose material, or in such material as is water-bearing, by means of the pneumatic caisson was well established by the year 1845. Credit for the first use of pneumatic pressure in building foundations is given to Smeaton by that great work, Ludwig Darmstaedter's "Chronological Handbook of Natural Science and Technology." This author states that in 1778 Smeaton sank the foundations for a bridge at Hexam, Northumberland, by the use of compressed air. In 1849 the French engineer, Triger, made use of the pneumatic caisson for driving through river sand at Chalonnes, France. A method used successfully in sinking foundations in the bed of rivers is that of the open cofferdam, a notable instance of which was the construction of the foundations for the Hawkesbury Bridge in Australia, which was built by American engineers. In this method, the excavation is done by means of dredges, generally of the clam-shell type, which excavate the material within the shell and thereby cause it to settle to the desired level. The most important use of the pneumatic caisson in the period from 1880 to 1890 was the construction of the massive piers for the Forth River Bridge. The cylinders were built with a double shell and provided with a massive cutting edge at the perimeter of the outer shell. At a suitable distance above the bottom, a strong, heavily-trussed steel roof was provided, and from this shafts provided with air locks led to the surface, one of them being used for the entrance and exit of the working crew, the other for the unloading of the excavated rock and other material.

The most extensive use of pneumatic caissons has occurred in the city of New York, in preparing the foundations of some of the tallest buildings in the world. Manhattan Island consists mainly of gneiss rock of very irregular contour, overlaid with river sand; the depth to rock varying from a few feet to two hundred feet and over. With the introduction of the skeleton-steel frame building, the weight of the superstructure was concentrated at certain defined points over the whole area covered by the building. In preparing the foundations, pneumatic steel caissons are sunk through the sand to a bearing upon solid rock, the caissons being filled subsequently with concrete up to the level of the footing of the steel columns. The building laws allow a maximum load of 15 tons per square foot, and upon this loading it has been possible, without exceeding the limit, to erect buildings to unprecedented height. The modern steel building, especially in the later types, is absolutely fireproof, the columns, the floor beams and all the main steel structural work being incased in terra cotta or some other fire-resisting material. The outer walls and interior partitions are carried by the steel framework, and this has made it possible to avoid the accumulation of pressure and consequent thickening of the lower walls, which were unavoidable in the tall buildings that preceded the age of steel construction. Had it not been for the introduction of the elevator, the towering office buildings of the present day would have been impracticable, but with their introduction and subsequent improvement, and notably because of the high speed at which they are run, there is no limit, so far as accessibility is concerned, to the height to which skeleton-steel buildings may be carried. The two loftiest structures of this kind in the world are the tower of the Metropolitan Life Building, which is 700 feet in height, and the 785-foot tower of the Woolworth Building, which is the highest office building in the world, and the highest structure of any kind with the exception of the Eiffel Tower. The future limitations of tall buildings will be due to legal restriction rather than to any inherent structural difficulties. Some years ago the SCIENTIFIC AMERICAN requested an engineer to prepare plans, showing to what height a building might be carried without exceeding the unit pressure of 15 tons per square foot, and it was found that, on a base 200 feet square, it would be possible to erect a structure that was 2,000 feet high, and that this building would be perfectly safe in the heaviest tornadoes that might blow against it.

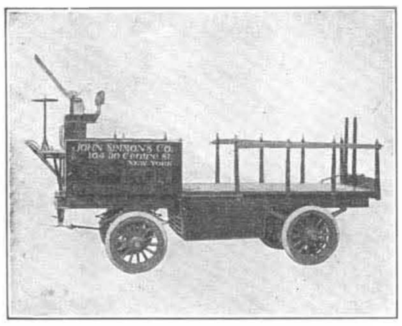
## The Invention and Development of Photography

*(Concluded from page 530.)*

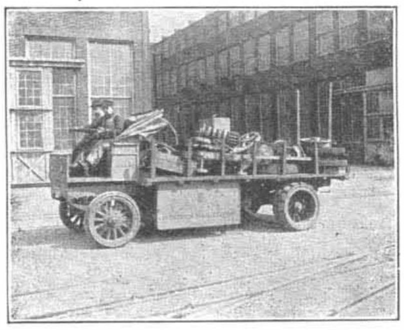
solution of bichromate of potash darkened when exposed to light.

The next was the discovery that gelatine, gum and other bodies were rendered wholly insoluble when exposed to light in combination with bichromate of potash.

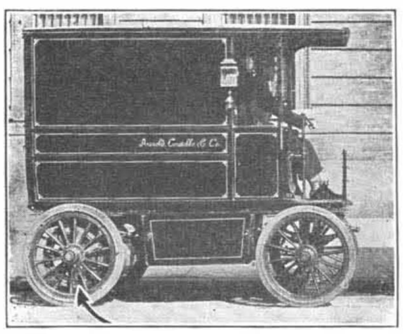
# A True Exponent of Progress—



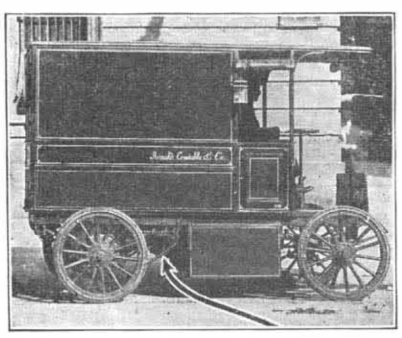
1—A 5-ton G. V. Electric built 1901. Double motor pinion drive. Note the overhang in front and the relatively crude steering mechanism.



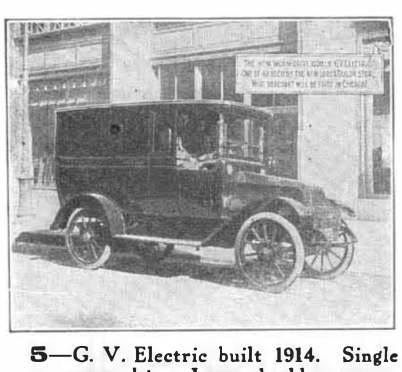
2—A 5-ton G. V. Electric built 1912. Single motor chain drive. Contrast this with the truck above.



3—G. V. Electric built 1902. Double motor *pinion drive*. Plain bearings. Right side lever steering. Mileage per charge 25.



4—G. V. Electric built 1907. Single motor *chain drive*. Steering wheel in centre, roller bearings. Mileage per charge 40.



5—G. V. Electric built 1914. Single motor *worm drive*. Long wheel base, steering wheel at left. Battery under hood. Two sets of brakes, interlocking safety devices. Mileage per charge 45-65.


6—Modern 5-ton G.V. Electric brewery truck. This brewer has gradually added to his G. V. fleet until to-day he has 126. He started in 1903.

## THE

# G.V. ELECTRIC TRUCK

THE "Scientific American" has recorded no more interesting phase of industrial progress than the growth of Motor Transportation. A decade or so has seen the city truck horse superseded by a trackless machine. A few years have modified our entire system of handling merchandise, at least in the larger cities.

And in this march of progress, in this inevitable working of economic law, the Electric Truck—and especially the G. V. Electric truck—has had an important part. It was the pioneer—the first motor competitor of the city horse.

A glance at the illustrations will show, in part, the evolution of the G. V. Electric. It was a trucking factor before the two cylinder automobile was efficient. In spite of the limitations of early design and power plant—in spite of prejudice and competition—it has steadily forged ahead. Today there are nearly 2,000 General Vehicle Electrics in daily service in New York City alone. This is more than 25% of all trucks employed in the city. G. V. Electrics are operating in 42 of the 48 states and 9 foreign countries.

## A Growing Confidence in Electric Delivery

Now that the Electric truck has demonstrated its long-lived efficiency—now that it is better understood—there is a growing confidence in the Electric method—yes—the Electric principle—of trucking and delivery. The more efficient motor trucking becomes the more Electric trucks will be used in their field. And this field takes in fully 80% of all average city work. This is being recognized and shrewd men are profiting thereby.

The Electric is *not* a competitor of the Gasoline truck. Both have their economical fields in which they are fundamentally superior. The trouble has been that some business men have ignored the Electric and paid an unnecessary premium on other forms of delivery in the Electric's field.

Twenty-five (25) big city firms already use 1,116 G. V. Electrics. This shows the logical preponderance of the high grade Electric in the city. Other firms are systematizing their delivery service and giving the horse, the Electric truck and the Gasoline truck each their economic place. The scientific application of motor trucking to his business should be studied by every business man and in that study we can help. And this is why:

## The Complete G. V. Line Includes All Types of Motor Trucks

Engineering counsel and co-operation can best be supplied by the strong, experienced manufacturer of motor trucks. The General Vehicle Company has developed *a complete line of commercial motor vehicles*. It builds *gasoline* trucks as well as electric trucks, *industrial* (or internal service) trucks, as well as road trucks. It has even supplied *gas-electric* trucks for special purposes. Six Electric models ranging from 1,000 to 10,000 pounds are provided and both worm and chain drive are available in the lightest types. Patrol wagons, street sprinklers, ambulances, power-dumping bodies, trucks equipped with winches and hoists, street cleaning tractors, trailers and many other types are provided. The Industrial Division, supplies Electric industrial trucks (as illustrated), industrial tractors, including "Electric mules" for the lumber trams, crane trucks and similar apparatus. No other manufacturer is in a position to so well serve the varied needs of the truck buyer as the long established General Vehicle Company.

We are prepared to impartially fit the right vehicle to the exact need. To supplement the Electric truck with the gas truck or to displace the hand truck. *Specific adaptability* is our watchword. This is why you can bring your trucking and delivery problem to us with every assurance of practical co-operation and help.

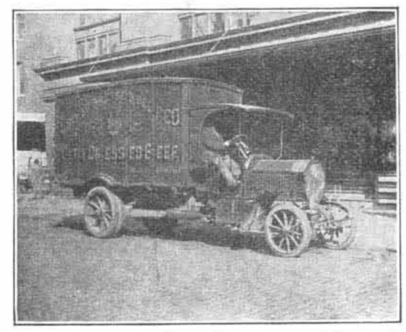
Catalogue 101 contains fascinating figures on ready-to-your-hand returns on improved delivery. Why not write for it?

# General Vehicle Company, Inc.

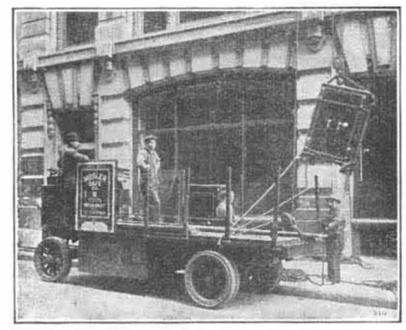
*General Office and Factory*

**Long Island City, New York**

NEW YORK CHICAGO BOSTON PHILADELPHIA



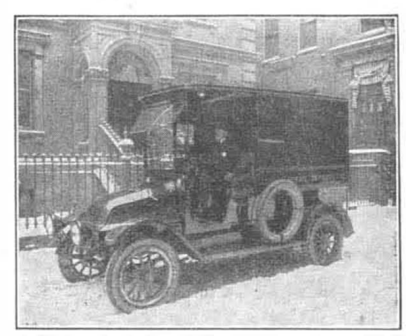
7—5-ton G. V. Mercedes (gasoline) Truck. The United Dressed Beef Co. operate 28 G. V. Trucks; 25 Electric and 3 Gas. The latter for the long fast hauls.



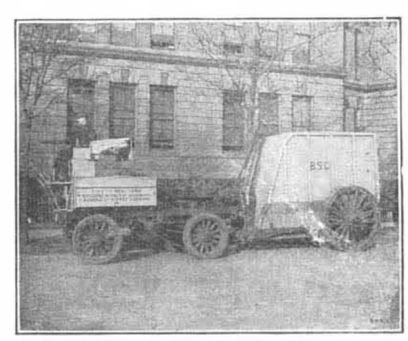
8—A Modern 5-ton G. V. Electric with winch. This winch is fed from the same battery which drives the truck. Very efficient.


9—5-ton G.V. Electric ice truck. One customer uses three with dump bodies for moving crushed ice. We have been very successful in the coal hauling problem also.

10—2000 lb. G. V. Electric Industrial Trucks. Hundreds of these are demonstrating to the manufacturer, the railroad and the steamship company that the hand truck, like the truck horse, is becoming obsolete. These Electric "stevedores" frequently displace 15 men each.



11—G.V. Electric worm drive patrol wagon. Practical, efficient, economical. Ample speed and mileage; compare it with the Lord & Taylor wagon.



12—G. V. Electric Street Cleaning Tractor. Very powerful and efficient. We are building 12 others for one city at the present time. Bring your problem to the General Vehicle Company.

This observation was first made by Mr. Becquerel.

The next idea evolved was that gelatine made insoluble by light, might be made to imprison particles of coloring matter. Where light acted, these would remain; where it did not act they would wash out by reason of the insolubility of the portion of the film in which they were contained. This was an important step and was made by Poitevin in 1855. The carbon process now used was invented and patented in 1866 by J. W. Swan.

### The Introduction of Dry Plates.

Although dry plates were proposed as early as 1854 by Gaudin in France and Muirhead in England, J. M. Taupenot seems to have been the first to have invented a practical dry plate. His process was cumbrous. It was not until Major C. Russell introduced the alkaline developer (1862), which necessitated the employment of silver bromide on the sensitized glass, that the dry plate really became workable by anyone. His dry plates are the forerunners of those we now employ in photography.

Up to the time of W. B. Bolton and B. J. Sayre's experiments (1864) silver iodide had been considered the staple of a sensitized film on which to take negatives. It occurred to them to bring the sensitive salts of silver in collodion while liquid and to form a sensitive film merely by letting the collodion, containing the salts in suspension, flow over the glass plate. Thus, the collodion emulsion process was born—a process which revolutionized photographic manipulations. M. Carey Lea of Philadelphia and W. Cooper, Jr., of Reading, placed the process on a commercial basis by improvements which made the plate more sensitive.

Since silver bromide emulsion could not be prepared in collodion, naturally experimenters began to cast about for collodion substitutes. The researches of Maddox (1871), King (1873), Burgess (1873), but above all the work of R. Kennett (1874) and C. Bennett (1878) resulted in the gelatine emulsion process of making dry plates.

### Development of the Photographic Camera.

The first photographic camera of which we have any account was simply a darkened room, the sunlight being reflected through a window by means of a mirror casting an image of the subject upon a sheet of sensitized paper. The next was a plain box with a plate holder fitted to the back, the lens being mounted in a tube and inserted in the aperture in front so that it would slide in or out as a means of focusing. Such was the camera used by Niepce and Daguerre in their earlier experiments, but in 1839 we find Daguerre using a camera composed of two boxes, one sliding within the other, controlled by a brass sliding rod underneath.

Then followed the camera with stationary front, the back sliding upon its base with a set-screw and connected with the front by means of a bellows.

The wagon load of paraphernalia necessary for the amateur's traveling outfit in the seventies and eighties, while it did not deter an enthusiast here and there, did prevent anything like widespread interest in photography. To simplify these processes and lighten the camera equipment itself were the problems that fell to the American inventor, George Eastman.

Dry plates were too heavy and cumbrous for the amateur. A thin, rollable, continuous, transparent strip, which would carry the negative, was required—something unbreakable and light. That need was supplied by the celluloid film which was invented by the Rev. Hannibal Goodwin in 1887. There can be no doubt that the celluloid film was also independently worked out by Eastman and his chemists; certainly the commercial film came from Eastman and his associates.

That the film camera—the kodak as we now call it—became as popular as it is must always be credited to Eastman. He and his chemists had worked on the film idea for years. They certainly developed a commercially practical method of producing films cheaply—at first using greased paper and finally adopting celluloid.

The important Eastman invention—the kodak—was a logical outcome of the roll film idea. The first kodak appeared in 1888. It took round pictures 2½ inches in diameter, had a fixed focus, and carried a roll of one hundred exposures. Compared with the little hand cameras we carry to-day, with so much pride, it was a rather crude and clumsy affair. But it marked a giant stride, and relieved the amateur of so much of his burden that photography henceforth became a pleasure instead of a drudgery. Its evolution proceeded simultaneously with the film discoveries, the evolutionary stages involving daylight loading, first by means of a black protecting cloth at each end of the spool, and later by the present cartridge system. This latter rendered obsolete all earlier kodak models and marked the beginning of the compact, convenient, and dainty models of to-day.

### Photographs in Natural Colors.

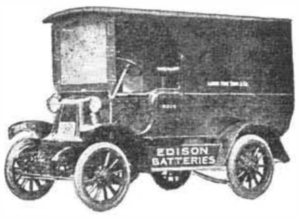
Long before the hand camera became as popular as it is, long, indeed, before photography became a general pastime, the taking of photographs in their natural colors engaged the attention of scientific men.

The original process used by Clerk Maxwell in his famous lecture at the Royal Institution in 1861 was an additive process, for he projected on a screen three lantern slides made from three negatives taken of a colored ribbon by means of three lanterns in front of which were glass troughs, these containing, respectively, sulphocyanide of iron, which is red; chloride of copper, which is green; and ammonio-copper sulphate, which is blue-violet in color. The lantern slide taken by red light was projected by red light, that from the negative taken by green light was projected by green light, and that taken by blue light was projected by blue light, the three pictures being superposed on one another, so that a colored image was seen on the screen, of which the report says: "If the red and green images had been as fully photographed as the blue, it would have been a truly colored image of the ribbon." This imperfection of Maxwell's result was undoubtedly due to his lack of photographic material appreciably sensitive to any colors other than blue-violet.

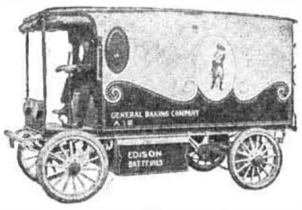
Since this first experiment the additive process of three-color projection has been used by many workers, the best known being Ives. In his famous "Kromskop" he modified the principle so that his apparatus could be used both for protection on a screen and also as a view instrument to be used by an individual observer.

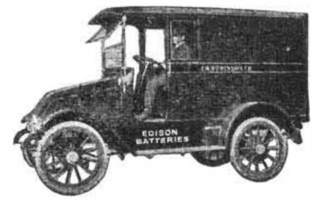
An entirely different application of the additive process of color photography is found in the screen plates, of which the best known example is the Lumière autochrome plate. The possibility of this method was first indicated by Ducos du Hauron in 1869, in the little booklet entitled "La Photographie des Couleurs," in which he outlined many of the processes of color photography which have since been realized in practice. The principle of the screen plate process is to divide the surface of the plate into a number of microscopic filter units—red, green, and blue-violet—and then to take the picture through these units upon an emulsion from which a positive is made either by reversal or by the ordinary photographic methods, this positive being registered with the screen, so that when the emulsion was blackened by exposure through one of the filter units, light is transmitted through that unit in the finished picture. The Lumière plate represents this process in its simplest form, the filter screen being coated upon glass and the emulsion on top of the screen, while the negative itself is reversed and converted into a positive, so that it remains always registered with regard to the screen.

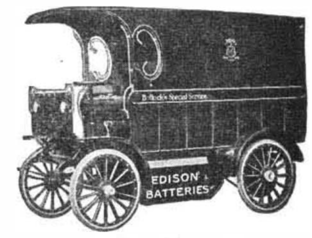
The subtractive processes depend upon the generation of colors by the superposition of the three complementary colors—blue-green, magenta, and yellow. Where magenta is superposed by yellow, we get


CHICAGO


WASHINGTON, D. C.


NEW YORK


SAN FRANCISCO


LOS ANGELES

I CLAIMED that the **New Alkaline Storage Battery** would make the Electric Vehicle the cheapest means of Street Transportation, but I had only my private tests to satisfy me. Today thousands of Edison Batteries in thousands of Trucks and Delivery Wagons are making Operating Records that are easily investigated by all. After the four or five years of hard service that many of these vehicles have had, is it possible to deny that my claim is proved?

Thomas A. Edison.

## The Status of the
# EDISON
## Nickel — Iron — Alkaline
# STORAGE BATTERY
## ON ITS *SIXTH* ANNIVERSARY

Over one-third of all the Electric Trucks and Delivery Wagons in the Country are Equipped with Edison Batteries. The few typical examples shown in the border prove that Buyers of the Best buy Edison.

* * * * * * * *

Seventy-five per cent. of the Industrial Trucks, Baggage Trucks, etc. are equipped with Edison Batteries. One-half of the Storage Battery Mining Locomotives are equipped with Edison Batteries.

* * * * * * * *

One hundred American Railroads are using the Edison Battery for Train Lighting or Signaling or both. The Edison Battery has placed the Lighting of Country Homes remote from Central Station Service on a practical basis. The Edison Battery has eliminated "battery trouble" from the Ignition and Lighting Systems of Gasoline Automobiles and Trucks. For Passenger Electrics and Motor Cycle Lighting the Edison Battery has taken the leading place.

* * * * * * * *

The Edison Battery Electric Safety Mine Lamp is the first to receive the approval of the U. S. Bureau of Mines for Safety and for Practicability and Efficiency in General Service (February 1915).

* * * * * * * *

The Edison "Wireless-Special" Battery has been adopted as an emergency source of power for radio apparatus and for emergency lighting by such large navigation companies as the United Fruit Co. and the Merchants and Miners Transportation Company.

* * * * * * * *

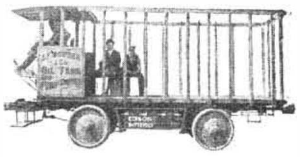
The President's Yacht "Mayflower" is lighted by an Edison Battery. The "Iolanda," "Vanadis" and "Sea Call" have the three largest storage battery equipments of any American Steam Yachts and are Edison-Equipped. Innumerable smaller installations all testify to the value of an Alkaline Battery in Marine Work.

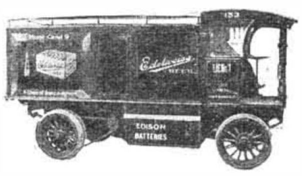
* * * * * * * *

The Edison Battery for Submarine Boats has been purchased by the U. S. Government for the Submarine now being constructed at Portsmouth, the first Submarine which this Government has ever undertaken to build in its own yards.

*An Exhibition of Edison Storage Batteries and their practical applications is being held in Transportation Building, Panama-Pacific Exposition*

**EDISON STORAGE BATTERY COMPANY, 132 Lakeside Ave., Orange, N. J., U. S. A.**

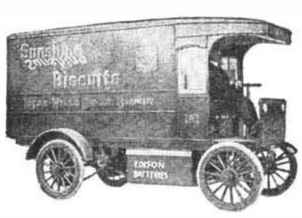

FORT WAYNE


CHICAGO

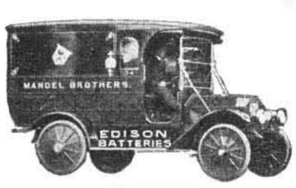

QUINCY


WINNIPEG

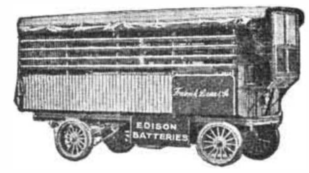
NEW YORK

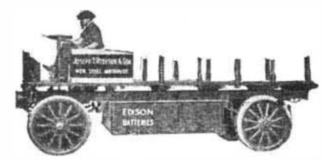

LONG ISLAND CITY


BOSTON

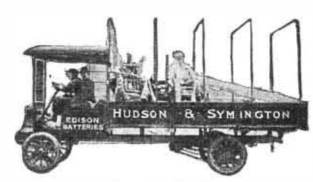


CHICAGO


BROOKLYN

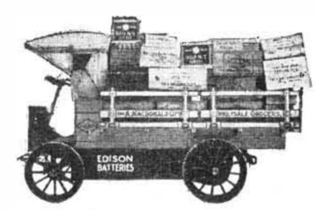

CHICAGO


NEW YORK

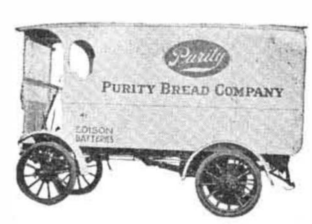


DETROIT


NEW YORK


WINNIPEG


BOSTON



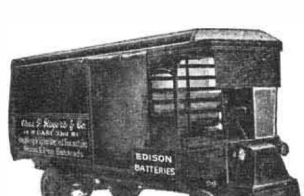
ST. PAUL


NEW YORK


BUFFALO


LOS ANGELES


SEATTLE



NEW YORK

primary red, the yellow absorbing the blue and the magenta the green light, so that only the red constituent of white light is left. By superposing the three in the requisite proportions, all colors can be reproduced. The method adopted in practice is to make three negatives through the three color filters just as in the additive process, and then to print positives from these negatives in such a way that the image consists of a colored dye, the commonest method being to print the negatives in bichromated gelatine. Three negatives are printed by this process, the negative taken through the red filter being printed on gelatine which is dyed blue-green, the one through the green filter on gelatine dyed magenta, and the one through the blue filter on gelatine that is dyed yellow. When the three colored transparencies are cemented together on top of one another, the result completely reproduces the colors of the original object. This transparency may be viewed in the hand or examined in front of an artificial light or projected in a lantern, or instead of this, a paper may be made by stripping off the three gelatine reliefs on paper; and some very beautiful results have been obtained in this way.

The simplest possible subtractive process will be one in which the original negatives themselves are directly transformed into color positives; therefore, the simplest possible color process will be one in which two negatives taken under two filters are directly transformed into the partial pictures for the two-color process, the red negative being turned into a green positive and the green negative into a red positive, and the two then superposed face to face to make the completed picture. Such a process would employ no loose films and only the minimum number of glass plates, while there would be no transferring of pictures from one glass to another. The final difficulty of registering also is reduced to a minimum. Moreover, if the original negatives can be actually transformed into a color positive, we may expect to retain in the positives all the gradation in the original negatives. The gradation by this process should consequently be as good as can possibly be obtained. Also, since there is no screen and the high-lights are represented by clear, unstained gelatine, the transparency of the picture should be equal to that of a black and white subject.

The direct transformation of a negative in black silver into a positive in which the silver of the negative was represented by clear gelatine and the places that were lightest in the negative by a full strength of any colored dye that might be chosen, the transformation being correct throughout, so that all the gradation of the original negative was reproduced in the resulting positive was a problem never satisfactorily solved until it was attacked in the research laboratories of the Eastman Kodak Company. It was this specific problem of transforming a silver negative into a dye positive, the working out of which made the new two-color "kodachrome" process possible.

The method adopted is to make the negatives on specially prepared panchromatic plates and through the correct filters, and then develop them as usual. They are then chemically treated so as to remove the black silver and leave the plate looking just like the colorless sheet of gelatine, showing no sign of an image. When this plate is put into the specially prepared dye bath, the dye goes into the gelatine most easily where the silver was absent in the negative; that is, where there was least light in the original photograph or in the part represented by deep shadows; while in the parts corresponding to the high-lights, where there was much silver in the negative, the dye penetrates more slowly, so that as the dye slowly enters the film, the original negative is transformed into a positive produced in a colored dye. While the one color is made in this way, the companion picture is also dyed in the other color, and the two, when placed together, make the finished picture. The process is thus seen to be simplicity in itself, the novel point of it being the method which has been worked out for transforming a black and white negative image into a colored dye positive. Since only two colors are used in the process, it is obvious that all colors cannot be correctly rendered, and the colors for which the process fails are the blues, violets, magentas, and purples. Light blues appear blue-green, and violets, black; magentas appear pink; and purples, dark brownish-red. On the other hand, flesh tints of all kinds, and all shades of red, orange or green grays and blacks are well rendered. As these are predominant in portraits, the results are more satisfying for this class of work than for outdoor work.

### How the Motion-picture Machine Was Invented.

In a certain sense, motion-picture photography is as old as photography itself. There is abundant evidence of the desire to produce visual representations of objects in motion, evidence embodied in such fantastically named toys as the Thaumatrope, Zoetrope (Wheel of Life), Stroboscope, Phenakistoscope, etc. Most of these are fifty years old and more. The first of them was invented by Dr. Coleman Sellers of Philadelphia, who took out a patent on February 5th, 1861, for what he called his "stereoscopic cabinet," but which came to be known as a "kinematoscope." Sellers must be regarded as the pioneer in the motion picture field.

In these early devices the pictures were usually arranged in a circle on cardboard and viewed through holes corresponding in number with the pictures. The pictures passed before the eye continuously and were seen for a greater or less time, according to the size of the hole. Sellers, the first in the field, differed from his contemporaries and imitators in recognizing the fact that the pictures should be entirely at rest during the moment of vision, a principle essential in motion-picture photography. The three vital features of a modern motion-picture apparatus are (1) a flexible ribbon picture carrier, (2) a mechanism for intermittently holding it before a lens, and (3) a place for the exhibition of the pictures to a great many people at the same time. Sellers's apparatus fulfilled the first two of these conditions; but his apparatus exhibited its pictures to one person at a time only. Because he introduced the intermittently moved ribbon-like picture carrier, however, Sellers is in a sense the father of motion-picture photography. Ducas of France in 1865 patented a ribbon-like picture carrier, the latter controlled by sprockets. Then came Donisthorpe, an Englishman (see *Nature*, January 24th, 1878); Marey of Lyons, France (1881), and Reynaud (1889) with the same idea. While all of these adopted and employed perforated picture ribbons, Marey employed the celluloid film.

### The First Public Motion Picture Entertainment.

To Henry Heyl of Philadelphia must be assigned the credit of having given the first motion-picture exhibition in the modern sense of the term. That was in 1870. His invention, the "Phasmatrope," was first exhibited in Philadelphia, at the American Academy of Music, February 5th, 1870, before an audience of more than 1,500 persons. The related photographs were small glass plate positives of selected subjects reduced from wet plate negatives, taken from successive poses, by an ordinary camera. The "phasmatrope," or exhibiting device, was a revolving skeleton disk around the periphery of which the glass positives were removably placed to register accurately as they intermittently came into the lantern rays. During the intervals between the rests of the disk a vibrating shutter cut off the light. The rotation of the disk was in absolute control by the operator so that the movements of the figures (two waltzers) were kept in perfect synchronism with an orchestra of forty musicians. Hence, we have here not only motion pictures, but the correlation of sound with motion. Mr. Heyl went even farther. He threw upon the screen a figure of a gesticulating "Brother Jonathan." The pantomimic gestures and lip movements of the moving

## 1845 - 1915

# Seventy Years of the New-York Life Insurance Company

THE New-York Life Insurance Company was organized in the same year the SCIENTIFIC AMERICAN was founded. There were at that time twelve American life companies, and the new insurance written during the previous year was about three million dollars. Of these twelve companies, nine survive, but only four are now taking new risks. The business of all American life companies in 1914—now over 200 in number—was about thirty-five hundred millions. The New-York Life's new business in a single week is now greater than the total yearly business of all the companies when the New-York Life was organized.

But New York was a small city seventy years ago, and the United States was geographically very large. The city had a population of less than 400,000; but one steam railroad—the Harlem—entered it. There were but 27 States in the Union, with a total population of about 20,000,000. There were less than 5,000 miles of railroad in the whole country, and the first iron rail was laid in that year. Chicago had about 10,000 inhabitants, San Francisco about 500, Minneapolis, St. Paul and Kansas City a few hundred, Omaha and Denver none. The first telegram had been sent less than a year before. The expenditures of the United States Government were less than $22,000,000. The slave-ship "Spitfire" was condemned at Boston in 1845, and among the first thousand policies written by the New-York Life were 339 upon the lives of persons of African descent who were held in bondage under the laws of the United States.

The first Annual Statement of the New-York Life showed the following:

| | | | |
|---|---|---|---|
| **Policies issued** | 449 | **Expenses** | $5,191.16 |
| **Amount insured** | $929,038.00 | **Net Assets** | 17,495.55 |
| **Premiums received** | 22,622.71 | **Insurance in force** | 799,000.00 |
| **Interest received** | 32.33 | | |

There had been no death-losses. The first death-claim was paid in November, 1846, was for $225, and was paid upon the life of a slave. There was a sort of irony in the fact that his name was Philip Swan! Such policies were always for small amounts, the term one year, with a seven-year rate. Sometimes several lives were insured under one policy; Policy No. 268 was upon the lives of ten slaves and one white man. The issue of slave policies was discontinued by direction of the Trustees in April, 1848.

The policies of the time gave the insured permission to travel and reside in the United States south of Virginia and Kentucky, BETWEEN NOVEMBER 1 AND JUNE 1, and that was considered liberal. To travel outside the settled limits of the United States, Canada, Nova Scotia, and New Brunswick, a permit must be obtained. Policies were absolutely forfeitable for (1) non-payment of premium, (2) death by the insured's own hand, (3) any untrue statement in the application, (4) death upon the high seas, in consequence of a duel, or at the hands of justice, or in the known violation of any law of the United States, or of any State or Province in which residence and travel were permitted. Military or naval service in time of war invalidated the policy.

It is now time to note how far we have come in the matter of business and in policy conditions. The Seventieth Annual Report of the New-York Life shows the following figures for the year 1914:

| | | | |
|---|---|---|---|
| **New Policies written** | 107,320 | **Expenses** | $13,293,067 |
| **Amount insured** | $226,674,121 | **Taxes, other than real estate taxes** | 1,309,601 |
| **Premiums received** | 90,467,178 | **Policies in force, Dec. 31** | 1,142,253 |
| **Interests, rents, etc.** | 35,799,396 | **Amount insured** | 2,347,098,388 |
| **Paid death-losses** | 26,230,268 | **Net assets, Dec. 31** | 799,838,591 |
| **Other payments to policy-holders** | 45,741,097 | | |

The changes in policy conditions have been almost as great as in the volume of business—if such things could be compared. Policies are now written practically without conditions except the due payment of premiums, provided present residence, occupation and habits of life are satisfactory. A suicide clause is operative for one year. Policies are automatically non-forfeitable after two years' premiums have been paid. Loans and cash values are available after two years. Policies are payable in case of death, not only in cash, but other valuable options are available, such as leaving the money with the Company at interest and drawing it out $100 at a time; payment in a selected number of equal annual instalments; an income for life, etc. Under the first of these options the New-York Life will pay the $100 in five $20 checks.

Another late feature introduced by the New-York Life is a disability clause, insuring against total and permanent disability. The benefits include the waiver of premiums due, and the payment of the face of the policy in ten equal annual instalments if the disability continues.

The advantages of life insurance are now so generally recognized that it has been adopted by the state, by business and by society, in one form or another, as the best method of replacing the earning power of the husband and father who dies prematurely.

What will the next seventy years bring to Life Insurance and to the SCIENTIFIC AMERICAN? Many amazing developments in science will be reflected in the pages of this publication. Is it too much to hope that within that period the savagery of international relations may be superseded by the law of human brotherhood—which is the great law of life insurance?

DARWIN P. KINGSLEY,
*President.*

346 Broadway, New York.

photographs coincided with the voice of a reader who supplied the audible words.

Perhaps the name of Edward Muybridge is the most conspicuous in the history of chrono-photography, although he was not the developer of motion-picture apparatus in the accepted sense. His remarkable studies of animals in motion were made with a battery of cameras. His work was of more scientific than of commercial value. Muybridge did design, about 1880, his "zoopraxiscope" to exhibit his glass plate positives of animal movements. This was more or less an exact counterpart of Heyl's "phasmatrope."

The devices of Mr. C. Francis Jenkins of Washington, D. C., deserve particular mention, for they seem to have established a type of projector which has continued until now. He was the first to have publicly exhibited in 1893 (before the Capitol Camera Club, Washington), and later in 1894, with an apparatus of a modern type. Lumière gave the first public demonstration in Paris in 1895 with his kinematograph—a combination camera projector which exhibited pictures of remarkable beauty.

In 1889 Edison made his first motion-picture camera in which a film was intermittently moved. His earliest form of exhibiting apparatus, known as the "kinetoscope," was a machine in which a positive print from the negative obtained in the camera was exhibited directly to the eye through a peephole; but in 1895 the films were applied to modified forms of magic lanterns, by which the images were projected upon a screen. Edison, however, was not held to be the creator of the modern motion-picture apparatus in a very important patent infringement suit decided a few years ago. Indeed, it is hardly to be expected that any one man could claim to have created the motion-picture machine as we know it. It is a composite, embodying principles discovered many years ago, each by a single investigator. But Edison certainly did fine work in developing the machine along the line of manufacturing details and much credit is due to him for that.

The standardization of the motion-picture machine is now world-wide. Films made in the most remote corners of the earth fit any machine in any theater anywhere. Hooks, as employed by Lumière, have become standard in cameras, while the intermittently rotated sprocket plan of Jenkins has been adopted on projecting machines in all countries. To Nicholas Power belongs the credit of having introduced many refinements which contributed to the perfection of the projecting apparatus, notably his devices for preventing the ignition of the highly inflammable film as it passes in front of the intensely hot arc light.

Of those who essayed to exploit machines combining motion and sound, not one can be considered pre-eminently successful. It seems no very difficult matter to synchronize the phonograph with the motion-picture projector and, indeed, dozens of patents have been taken out for synchronizing devices. The fault seems to lie more with the sound reproducing devices than with the motion-picture machine. The phonographic voice is certainly not so natural as the animated picture.

**Motion-picture Photography in Colors.** Motion-picture photography in colors depends upon the same principles as ordinary photography in colors. In addition to one or two processes which are only of laboratory interest, all methods of color photography consist of applications of the three-color theory of vision, depending upon the fact that any color may be matched by a combination in the proper proportions of the three primary colors—red, green, and blue-and-violet. There are two main methods by which the combination of these colors can be achieved and a color picture, either still or in motion, produced, these being termed, respectively, the additive and subtractive methods.

Of the photographic color schemes in chrono-photography, the Smith-Urban kinemacolor process is prominent. This is a process in which two colors are used instead of three. Positives made from a red and green negative are projected alternately upon the screen through red and green filters. While the color rendering in this process is quite pleasing, the correctness is much inferior to that of the three-color process, but the results obtained are sufficiently encouraging to justify the belief that a slight improvement in color rendering over the results obtained by this two-color additive process is satisfactory for many purposes.

One of the latest applications has been the Gaumont three-color process, where three cinematograph pictures are taken on films of the usual width, one over the other, through three lenses, the pictures being somewhat reduced in height so that the three pictures are two and one quarter times the length of the ordinary black-and-white picture, the film being moved after each exposure through the length of the three pictures. Projection is accomplished by means of a very ingenious triple lens, each positive being projected through its own lens system and filter.

## Communicating Over Great Distances

(Concluded from page 532.)

opening the old Reis-Bell controversy, it must be said that there is grave doubt whether Reis's instrument ever did or could transmit speech, whereas there is no doubt at all that Bell's instrument did transmit speech. The correct idea of the telephone also occurred to Elisha Gray, who, however, filed a caveat in the United States Patent Office only a few hours after Bell, with the result that all the commercial fruits of one of the greatest discoveries in the world slipped from his grasp Bell's patent has been called "the most valuable single patent ever issued" in any country. That is probably true; for its claims cover not merely an instrument, but the whole art of transmitting speech over a wire. When the telephone was placed upon a business basis by Gardiner Hubbard (to whom America owes very much indeed for the encouragement which he gave Bell and for his business acumen, and broad-mindedness) the Western Union Telegraph Company realized that a formidable competitor of the telegraph had appeared. It organized the American Speaking Telephone Company, and engaged Edison, Gray and Dolbear as electrical engineers. These three men, as well as Berliner, Blake, Hughes, and others, developed the telephone and made it a really practical commercial instrument. In 1877 Berliner invented the loose-contact transmitter and applied the induction coil between transmitter and receiver. These two inventions have ever since been applied in all practical telephony, and no other devices have taken their places in practice. Both of these are essential elements of the telephone as we know it. In Bell's instruments sound vibrations impinge upon a steel diaphragm, arranged adjacent to the pole of a bar electro-magnet, whereby the diaphragm acts as an armature, and by its vibrations induces very weak electric impulses in the magnetic coil. These impulses, according to Bell's theory, correspond in form with the sound waves, and passing over the line, energize the magnet coil at the receiving end, and by varying the magnetism, cause the receiving diaphragm to be similarly vibrated to reproduce the sounds. A single apparatus is, therefore, used at each end, performing the double function of transmitter and receiver. With Berliner's improvement a closed circuit is used, on which is constantly flowing a battery current, and included in that circuit is a pair of electrodes, one or both of which is of carbon. These electrodes are always in contact with a certain initial pressure, so that current will be always flowing over the circuit. One of the electrodes is connected with the diaphragm on which the sound waves impinge, and the vibration of this diaphragm causes the pressure between the electrodes to be correspondingly varied and thereby effects a variation in the current, resulting in the production of impulses which actuate the receiving magnet.

(Concluded on page 570.)


# Toughness with Resiliency —at Low Prices

FIRESTONE Most-Miles-per-Dollar tire service is due to the Firestone combination of unequaled toughness with extreme resiliency. Firestone tires have the "life," the firmness, the come-back, to bear the crushing strains, and at the same time give the utmost protection to the truck mechanism. There is a Firestone for every road, load and condition of service.

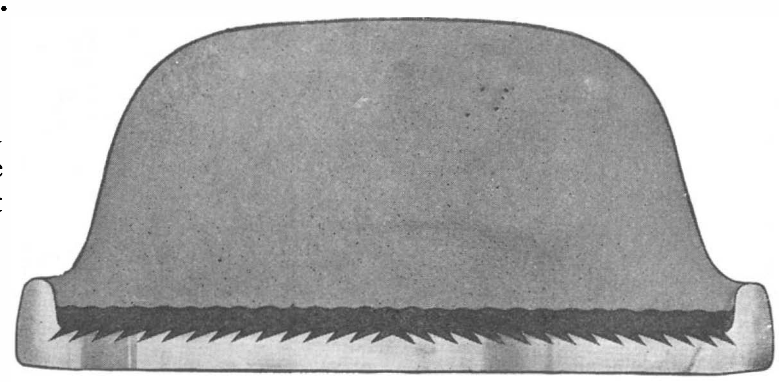
## Firestone Removable Rim Equipment

means maximum service, because it means continuous service. Any driver can change tires. Insures against delays and truck layups. Proved in every kind of service. Get the facts. Built to S. A. E. measurements. Interchangeable. Enables you to equalize wear on tires and obtain longest use, a necessity to the operator far removed from a service station.

## Firestone Pressed-on Type

have the unequaled Firestone resilience and tough wearing quality. Cured in the rim, insuring an absolutely perfect seating. Applied direct to felloe bands under great pressure. This method of fastening greatly reduces weight of equipment, especially important on electrics. Creeping is impossible.

At the Firestone branch in every great trucking center, large stocks of tires are carried, with complete facilities for applying or changing tires, or building a wheel from the hub out. Use the Firestone service.



***Let a Firestone man call and advise with you and quote our new low prices***

**Firestone Tire and Rubber Co.,** *"America's Largest Exclusive Tire and Rim Makers"* **Akron, Ohio** **Branches and Dealers Everywhere**

## NEW BOOKS, ETC.

Defenseless America. By Hudson Maxim. New York: Hearst's International Library Company, 1915. 8vo.; 318 pp.; 20 illustrations. Price, $2.

The purpose of this timely and excellent work is aptly expressed in the opening paragraph of the preface: "To present a phalanx of facts upon the subject of the defenseless condition of this country, and to show what must be done, and done quickly, in order to avert the most dire calamity that can fall upon a country—that of merciless invasion by a foreign foe, with the horrors with which no pestilence can be compared." While the above expresses the purpose of the book, which is admirably fulfilled, the scope of "Defenseless America" is so all-embracing, that the author has given us a veritable mine of information upon the subject of war and war material. Mr. Maxim is well qualified by his long and successful association, as a practical and successful inventor, with the production of the implements of war, to write upon the technical side of the question; and this he does with a characteristic force and lucidity which will render the subject perfectly understandable and full of fascinating interest for the average layman. We refer, here, to the six chapters entitled: Modern methods and machinery of War; The needs of our Army; The needs of our Navy; Language of the big guns; Aerial warfare; and Our armaments not a burden. The author writes with a trenchant pen and his logic is as merciless as it is pungent. Nowhere are these qualities used with such telling effect as in the chapters wherein he exposes the fallacies and the unconscious cant of the so-called "pacifists." Did this voluminous work contain nothing more than this analysis, or shall we say vivisection, of the most fallacious and dangerous doctrines that ever have menaced the very existence of the country, the book would be well worth its purchase price. The subjects for illustration have been well chosen and they are highly illuminating. The present war will be won mainly by artillery—an arm in which we are wofully deficient, as shown by the plate, page 104, which credits Russia with 6,000 field guns, Germany with 5,000, France with 4,800, Austria with 2,365, Japan with 1,250 and the United States—twice as rich as the next richest nation—with 634. The author shows in much detail how relatively weak is the United States navy compared with the vast and far-flung territory, coastline, wealth and population which it has to defend—to say nothing of the possible seeds of war which exist in the great national policies, such as the "Monroe Doctrine," the "Open Door" in China, Asiatic exclusion, and the preservation of the neutrality of the Panama Canal. Perhaps the most astonishing to the average reader of the illustrations will be one showing, diagramatically, a comparison of the casualties of Peace and War. From this we learn that the total number of killed in six wars, viz., our losses in the wars with Spain and Mexico, our Civil war casualties on the Federal side, the the English in the Boer war. the English and French in the Crimean war, and the Japanese killed in the Russo-Japanese war, together totaled 75,982, whereas the average annual number killed in the United States during peace is 79,000.

Perfumes and Cosmetics. Their Preparation and Manufacture. By George William Askinson, Dr.Chem. New York: The Norman W. Henley Publishing Company, 1915. 8vo.; 344 pp.; 32 engravings. Price, $5.

In this translation from the German the fascinating subject of perfumes is comprehensively presented by a manufacturing chemist. A brief history of perfumery and a general discussion of aromatic substances fitly leads into the more practical considerations of the employment of vegetable and animal substances and of chemical products in the manufacture of perfumes. The methods and apparatus employed in the extraction of odors are carefully explained and described. Among other chapters worthy of especial note are those on synthetic products, the classification of odors, fumigating pastils, pencils, and powders, and the antiseptic and therapeutic value of perfumes according to the evidence of manufacturers and bacteriologists. Of course a very large portion of the space is devoted to formulæ and directions. Cosmetics, dentifrices and other toilet preparations receive an adequate share of attention. The work may be accepted with confidence, and many of its products are very easily prepared.

The Official Good Roads Year Book of the United States. Washington, 1915. Colorado Building.

The Good Roads Year Book is an excellent compendium of laws, technical improvements made in the development of good roads, financial considerations governing the building of good roads, and the like. An excellent article is that on road systems of foreign countries, giving very tersely the road mileage of each country, and the cost of maintenance per mile. How little or how great is the interest of the individual states of the union in good roads is exhibited by a consideration of State legislation. A good digest of convict labor laws shows how far convicts may be employed on roads. The principal types of roads are described in a good article on the subject. The State funds available for road work are carefully tabulated. Taken as a whole, the book gives one an excellent idea of the good roads movement in this country.

The Secret of the Universe. By Eugene Miller. Topeka, Kansas: Crane & Co., 1915. 8vo.; 255 pp. Price, $1.60.

When we approach that borderland between the universe of things and the universe of thoughts, it is strange how slight an argument will sway one man, and how weighty a consideration may fail to convince another. For more than 150 pages Mr. Miller gives us an exceptionally good example of popular philosophical writing. Then, suddenly, he "lays down the proposition that nothing can either 'conform to law' or 'obey law' without knowing;" hence that the corpuscle, the unit of matter, is intelligent; in short, that it is the mental unit as well as the physical. We cannot accept his startling proposition as axiomatic—and he offers no proof of it as a general proposition—unless we wrench the word "intelligence" out of its accepted usage, in which case the whole argument is annulled. Once we accept the corpuscle as the unit of both matter and mind, however, the way is opened for a series of original and brilliant hypotheses giving a wide and not unattractive interpretation of natural phenomena, and particularly of the origin and nature of gravity. The chapter on heat, light, and electricity continues these bold speculations, and the sheer force of its heterodoxy may really illuminate a few dark places.

Pocket Guide to Printing. Compiled by George Vickers. New York: Oswald Publishing Company, 1915. 16mo.; 46 pp.; illustrated. Price, 50 cents.

The American Handbook of Printing. Containing in brief and simple style something about every department of the Art and Business of Printing. New York: Oswald Publishing Company, 1913. 8vo.; 300 pp.; illustrated. Price, $2.15.

The author, the advertisement writer, the business man—anyone, in short, who contracts for printing or furnishes material for setting up—will find this compact little "Pocket Guide to Printing" very useful. It shows the standard type faces, gives the old and the new size-names, explains proof-reader's marks, and lists paper sizes and weights commonly stocked, together with a fund of miscellaneous information upon other details pertaining to the art of the printer and illustrator. The third edition of "The Handbook of Printing" has been subject to careful revision and to some measure of reconstruction. In its original form the handbook was intended as a short cut to a printing education. Its numerous sections take captions such as "Type Making," "Type Faces," "Proofreading," "Inks," and "Presses," and a rather unusual method is followed, in that each section first presents the historical side of its subject, and immediately follows with practical considerations. This plan has its distinct advantages. The work includes a color chart as a guide to the mixing and harmonizing of colors. The whole makes up a handy desk manual that will prove exceedingly helpful to the printer and the advertiser.

The Foundations of Strategy. By Capt. H. M. Johnstone, Military Lecturer to Edinburgh University. New York: The Macmillan Company, 1914. Price, $1.60.

Capt. Johnstone has written both a timely and an instructive book. Using the campaigns of the last hundred years as a basis of discussion, he gives us a clear insight into the manner in which great generals conduct their operations. Capt. Johnstone is evidently a believer in the principles followed in the present campaign, a believer, in other words, in the "full strength" idea that is now applied on so magnificent a scale in Europe. For all that the book was written without any reference whatever to the present campaign in Europe. Some excellent maps, very clear and large, simplify the readers' task of following the author's explanations.

Wetterkunde für den Wassersport. Von Dr. E. Mylius. Berlin: Verlag Dr. Wedekind & Co., 1914. 8vo.; 108 pp.; 21 plates. (Yacht-Bibliothek herausgegeben von der Redaktion der Zeitschrift "Die Yacht," Band VIII.)

The author of this unique book is not a professional meteorologist, but an enthusiastic yachtsman who has become "weather-wise" through many years' careful observation of winds and skies, supplemented by a study of meteorological text-books. Persons who lead an out-of-door life usually acquire more or less skill in predicting weather changes a few hours in advance—and it is such forecasts of short range that are useful to the yachtsman—but very few take the trouble to formulate their knowledge so that it may be readily imparted to others. Dr. Mylius has not only set down in writing the results of his observations, but he has produced several hundreds of drawings of the sky, and noted in connection with them the antecedent and subsequent weather. A selection of twenty-one of these drawings appears in his book, all of them typical and true to life. This is probably the best feature of the work. The author begins with a sketch of the general subject of winds and weather in relation to barometric conditions (cyclones and anti-cyclones), gives a description of cloud forms, and tells all that the yachtsman needs to know about weather maps and official weather forecasts and warnings. He points out the fact that the maps and forecasts have their limitations from the sailor's point of view; they are not always promptly accessible, and in any case he is mainly interested in weather changes of a local and rapid character. The scope of the book is indicated by the following chapter-heads: 1. Origin of the weather in western Europe. 2. Weather maps available for our use. 3. Personal observations. 4. Weather changes from good to bad. 5. Weather changes from bad to good. 6. Squalls and thunderstorms. 7. Waterspouts. 8. Calms and wind-shifts. 9. Wind direction and force. 10. Stormy weather and storm warnings. 11. Storm signals. 12. Rainy weather. 13. Currents in the Baltic and adjacent waters. 14. Waves. The *novel* portions of this book are little less useful to the American than to the German yachtsman; for information concerning weather maps and the like the American would naturally consult cis-Atlantic publications.

## INQUIRIES

*Inquiry No. 9437.* Wanted the name and address of a concern that can make an oil or grease gun. West preferred. Must be able to make in quantities of 10,000.

*Inquiry No. 9438.* Wanted the name and address of a manufacturer of light aluminium sheets, small tubing, rods and wire, also aluminium solder.

*Inquiry No. 9439.* Wanted the name and address of a manufacturer of a knitting machine which was on the market some years ago. The name of the machine was the Bickford Machine. It was a hand knitting machine, weighing about 15 pounds.

*Inquiry No. 9440.* Wanted the name and address of a concern selling Dr. Young's E-Z Sanitary Belt.

*Inquiry No. 9442.* Wanted the name and address of a manufacturer of a machine for cutting skeins of cotton and wrapping each bundle around the middle with wire. A machine of some such kind is used in the brush trade for wiring and cutting to length the bundles of bristles for paint brushes.

*Inquiry No. 9443.* Wanted the name and address of manufacturers of fuel oil burners and fire wall equipment, suitable for a maximum quantity of water evaporation in a locomotive firebox of the following dimensions: 2½' between door and flue sheet, 3' between grate level and crown sheet, 3' between side walls.

*Inquiry No. 9444.* Wanted the name and address of a manufacturer or patentee of a glass preserving jar made for use with air pumps for creating a vacuum.

*Inquiry No. 9445.* Wanted the name and address of a manufacturer who can make a combination pencil holder and point protector.

*Inquiry No. 9446.* Wanted the name and address of a manufacturer who can supply machinery for automatically wrapping cigars in thin imported tissue paper having the ends tightly wound and curled. Would consider purchase of machines or patent rights.

*Inquiry No. 9447.* Wanted to buy patented article, which is needed in every home, with a possible view to manufacturing and distributing.

In other words, with Bell's telephone the sound waves themselves generate the electric impulses, which are hence extremely faint. With the Berliner telephone the sound waves actuate an electric valve, so to speak, and permit variations in a current of any desired strength. All that now remains of the original Bell telephone is the receiver, which is still in essence what he made it.

In Gray's caveat, which he unfortunately filed in the Patent Office too late, it is pointed out that the variations of the current may be produced by causing the vibrations of the diaphragm to vary the resistance of the circuits. This is really the beginning of the microphone transmitter.

Herbert N. Casson, in his "History of the Telephone," summarizes transmitter development thus:

"From first to last the transmitter has been the product of several minds. Its basic idea is the varying of the electric current by varying the pressure between two points. Bell unquestionably suggested it in his famous patent when he wrote of 'increasing and diminishing the resistance.' Berliner was the first actually to construct one. Edison greatly improved it by using soft carbon instead of a steel point. A Kentucky professor, David E. Hughes, started a new line of development by adapting a telephone into a microphone, a fantastic little instrument that would detect the noise made by a fly when walking across a table. Francis Blake of Boston changed the microphone into a practical transmitter. The Rev. Henry Hunnings, an English clergyman, hit upon the happy idea of using carbon in the form of small granules. And one of the Bell experts, named White, improved the Hunning transmitter into its present shape. Both transmitter and receiver seem now to be as complete an artificial tongue and ear as human ingenuity can make them. They have persistently grown more elaborate, until to-day a telephone set as it stands on a desk, contains as many as 130 separate pieces, as well as a saltspoonful of glistening granules of carbon."

Such men as Carty, Scribner, and Dean have brought the telephone to its present perfection. The one man who did most to create the switchboard is Charles E. Scribner. Of the nine thousand switchboard patents granted, Scribner holds six hundred or more. It was he who devised the first jack-knife switch in 1878, although the first modern multiple switchboard was proposed by L. B. Firman in 1879. Joseph O'Connel of Chicago in 1887 conceived the use of tiny electric lights as signals. In 1901 J. J. Carty invented the bridging bell, a method of putting four houses on a single wire, with a different signal for each house, thus realizing the party line in a practical way. The common battery system was introduced in 1896.

One of the most remarkable improvements in telephone apparatus which has been made within recent years is the "Load Coil" of Prof. M. I. Pupin, brought out about 1899. Pupin introduced coils in telephone circuits in order to obviate the bad effects of capacity, by increasing the self-induction. Thanks to this invention, it is possible to communicate over extremely long distances. Indeed in 1915, telephonic communication was established between New York and San Francisco with the aid of the Pupin coils. The economic effect of the invention is remarkable. Thin wires were made to work as effectively as thick wires, thereby saving millions of dollars in copper.

An interesting type of speech transmitter is that dependent upon the variations in a beam of radiant heat or light. Such apparatus are designed on the principle that selenium varies in electrical resistance when exposed to light or radiant heat. Experiments were made by Bell and Sumner Painter over thirty years ago, which proved that if a beam of light be reflected from a mirror to a bar of selenium which is in the circuit of a telephone and battery, the telephone will repeat words spoken to the mirror. Perhaps the most efficient type of photophone, as this instrument came to be called, was that developed by Ernest Ruhmer of Berlin, about ten years ago.

### The Automatic Telephone.

The history of the first creation and subsequent development of automatic telephone equipment, by which connections between the various stations in a system are established through mechanical means,

instead of by a human operator, covers a period of approximately twenty-seven years, for while as early as 1879 there were attempts made to solve the problems of mechanical switching, these were abortive and led to nothing tangible. It was on March 12th, 1889, that Mr. Almon B. Strowger, at that time an undertaker in Kansas City, Mo., filed his first application for a patent covering a system of automatic telephony, and although the equipment there described was very crude, it embodied many of the essential principles found in the apparatus to-day.

The first specifications cover the terminating of subscribers' lines on contacts arranged in layers or levels on the inside of a section of a cylinder, and of connecting them with other lines by means of wipers fixed on a shaft having a vertical and rotary movement. The first mechanism required seven wires from each station to the central office mechanism, which was controlled by means of push buttons mounted on the telephone. Pressing one of these buttons the proper number of times sent current to a magnet which lifted the wiper shaft to the desired level. Pressing a second button sent current to a second magnet, which caused the shaft to revolve, bringing the wipers into contact with the line leading to the called telephone. A third button was used to ring the bell, and at the end of the conversation, the connection was released by pressing a fourth button, which caused a magnet to withdraw the detents which held the shaft in position. Strowger was not an electrical expert. While his invention was extremely crude and impractical for actual service, it contained many possibilities of development. Mr. Alexander E. Keith, an electrical engineer, became interested in the subject. Under his guidance the improvement of the apparatus began at once, and has continued uninterruptedly for the past twenty-five years.

A review of the history of the adoption of automatic equipment shows that the first public exchange was installed in La Porte, Ind., in 1892. Since that date some one hundred and fifty other exchanges have been installed in the United States, especially in the Central and Western States.

**Facsimile Telegraphy and Phototelegraphy.**

Telautography, or telegraphic transmission of a facsimile of handwriting, or drawings, and phototelegraphy, or telegraphic reproduction by a receiver of a picture sent by a transmitter are in their present states the slow results of the experiments of many inventors during a long period of years. The first device of all, a copying machine intended especially for transmitting print, was invented by a Scotchman, Alexander Bain, who obtained a patent for it in 1843. In this each letter was formed by a number of lines, each line being transmitted by a special wire. The lines were produced by a comb containing insulated metal points, which glided over the type to be transmitted. A similar comb at the receiving end reproduced the lines on a chemically prepared paper. Bain proposed to copy the type with one metal point alone, omitting the comb and transmitting one line after another, but the patent does not make clear how the lines were put together. Bain's method was later taken up and improved by Bonelli, who exhibited his apparatus at the London Exposition of 1862. The next and more practical copying machine was that of Bakewell, who in 1847 transmitted handwriting. Metal foil inscribed with insulating ink was wrapped around a cylinder, the rotation of which by clockwork caused a metal style to glide over the foil. The same conditions existed at the receiving cylinder, except that chemically prepared paper was substituted for the foil. With each rotation the styles shifted slightly toward the axes of the cylinders, and an effort was made to keep the rotation synchronous.

All succeeding copying processes rest upon either Bain's or Bakewell's theories, the first making use of the oscillation of a pendulum, the other employing the rotation of a cylinder. Hipp's invention (1851), although of little practical value, introduced a new element, an electro-magnetic receiving device to replace the electrochemical one. Every electric impulse from the transmitter brought a small electro-magnet into action, which caused an automatic pen to be pressed against ordinary writing paper. Caselli's "Pantelegraph" (1855) had reciprocating action, metal foil, and better synchronous movement. This was the first device to come into actual service, being used for a time between Paris and some French provincial cities. The Alsatian, Meyer (about 1864), brought out an apparatus with electro-magnetic receiver, the novelty being in the helix, which takes the place of the receiving metal style. This was the first electro-magnetic copying telegraph to come into practical use. Gérard (1865) devised a metal style that moved in spiral lines like the needle of a gramophone, but the idea led to no result. Also in 1865 Hubert, a Frenchman, proposed replacing the insulating marking on the foil by heavy marking forming a kind of relief. This idea was developed later by others. Lénoir, who in 1867 proposed an original method of synchronism, is said to be the first to suggest transmitting photographs by the telautograph, after reduction to black and white. He was also the first to lay carbon paper upon white in a receiver. In 1868 D'Arlincourt produced an improved synchronism in which tuning-forks were employed for the first time in a telautograph. His theory is largely used at the present time. In the seventies, Sawyer, an American, introduced the pressing of the paper containing the writing to be transmitted on a zinc plate, thus making a printing plate, also a method of writing in relief or embossed lines for the transmitter. Relief writing was furthed developed by Edison in the early eighties, and by Denison in the middle of the eighties. De Hondt (1874) obtained synchronism by using a special line aided by a vibrating pole-changer, and Sheehy (1893) by a special line aided by alternating current motors. Bain's idea in the formation of letters was revived by Parcelle (1882) and Brooks (1884), who used alternating currents of different frequencies. Hummel's telediagraph and the electrograph of Dunlany, Palmer and Mills, which appeared at the close of the last century, are copying telegraphs with electro-magnetic receivers.

The telautograph has also proved capable of working in connection with wireless telegraphy. The idea was first brought out in the patents of Küster (1898), and Greville-Williams (1899) and was further developed by Braun (1903), Pansa (1904), Garcia (1908), and Knudsen (1909). In all of these apparatus the conductive part of the transmitting foil closes the primary current of a Ruhmkorff coil by the aid of which electric waves are sent out. At the receiving end a coherer closes a local current during the arrival of the waves from the transmitter. Among the telautographs based upon this method which have had practical demonstration are those of Berjonneau (1907)), Thorne Baker (1909), and Korn.

In another form, the telautograph, instead of copying the original in fine lines at the receiver, makes a recording pen follow the movements of a pencil writing at the transmitter. The idea is that the movement of the point of the pencil on a level surface is made up of two components which can be sent separately by quantitative or pulsatory currents and recombined at the receiver. The first person to suggest transmitting handwriting in this way was the Englishman Jones (1855); then came Lacoine (1857) and Bienayamé (1858), who proposed a separation by rectangular co-ordinates. In 1878 Cowper, an Englishman, made the first actual long-distance writer working on the two component principle, using in it quantitative transmission. In 1881 Jordery, a Frenchman, demonstrated a model at Paris. In 1885, Robertson, an American, brought out a device which is a development of Cowper's ideas. In 1886 Höpfner suggested separation by polar co-ordinates. O'Brien's method (1888) was very much like that of Elisha Gray, who in the same year brought out his first apparatus.

Gray's tranmission was by pulsatory current; the receiver had two pairs of electromagnets, the pairs differing in the exciting polarity. Gray's ideas were further developed by Tiffany (1895) and MacPherson (1897). On very much the same principle was Ritchie's "telewriter" (1899). Tiffany and Ritchie used quantitative transmission. In 1902 the "Graz annagraph," somewhat similar to Gray's, but with a photographic reproduction in a receiver, was brought out by a company at Dresden. Cerebotani (1904) used a method by pulsatory, also very similar to Gray's.

The development of the copying telegraph into a photographic recorder was a very natural one. Little (1867) was the first to suggest a photographic recording process for telegraphic signs; Dillon (1879) first proposed a photographic receiver for a telautograph; Cellino (about 1901), like Dillon, used a mirror galvanometer in the receiver. The next advance over this was the transmitting of photographs. Four methods can be used in transmitting photographs by telegraph, which, in order of practicability, are: 1, telautographic transmission; 2, by the aid of selenium in the transmitter, with use, in some cases, of progressive relays of light and intermediate *clichés;* 3, a relief method; 4, what may be called the statistical method. In the telautographic process the photograph to be transmitted is first changed to black and white by means of a glass screen. Carbonnelli, a Belgian, who brought out (1906) an apparatus with a telephone diaphragm instead of a magnetic relay in the receiver, in the end confined himself to reproducing black and white pictures. Berjonneau and Thorne Baker (the telectrograph with electrolytic apparatus in receiver), both brought out methods for reproducing photographs.

The second method is based on the sensitiveness to light of selenium, a discovery made in 1873 by the English engineers, Willoughby, Smith and May. Senlecq (1877), a Frenchman, suggested applying the varying conductivity of selenium under changing conditions of light to the telegraphic transmission of a photograph, which he proposed to reproduce as a fixed, visible object. Bidwell, an Englishman, in 1881, suggested a better method in which he used the changing resistance of selenium to give the values of the picture in the transmitter and electro-chemical reproduction. The selenium cell was improved, especially by Giltay of Delft, and Korn (1902) brought out a further photographic method. In this a bright light concentrated on a portion of a transparent film attached to a glass cylinder is thrown from a totally reflecting prism within the cylinder upon a selenium cell at end of cylinder. Rapid changes of current are received by a galvanometer at the receiver, and the developed picture consists of a number of parallel lines varying in tone. Frikart (1906) proposed transmitting photographs by wireless.

In the relief method variations of light and shade are expressed by the heights and depths of a relief print which are traversed by a style. By the aid of resistance devices these differences produce variations of current. The method was first proposed in 1880 by Eaton, an American, who suggested a diaphragm carrying a spirally moving style in the transmitter and one carrying a pen in the receiver; the latter was to be pressed by a magnet upon the paper and the picture produced in a spiral line. An apparatus with wax cylinder in transmitter and wax relief in receiver was devised by Amstutz about 1891; Kiselzka (1896) used a continuous current with variation of length of the closing of the current. The longer the closure the more light fell upon the photographic plate of the receiver. In 1903 Sémat proposed a vibrating telephone diaphragm to cause fluctuations of current. In 1907 Bélin a Frenchman, used an oscillograph in the receiver, its movement regulating the light falling upon the photographic film. Senlecq and Tival (1907) made some not very practicable suggestions as to the use of intermediate *clichés* (carbon or pigment prints), but the prin-

ciple of the Adamian method (about 1907) of transmitting variations of tone by intermediate *clichés* has more value.

In the statistical method the picture is divided into a large number of small squares, the values of which are estimated and sent as numbers or combinations of numbers in an ordinary telegram, which is then traced out on a correspondingly ruled paper. Gras (1897) proposed such a method for simple outlines. The same idea was brought forward by Rickinson in 1889. In 1895 Willoughly obtained a patent for a somewhat improved invention. A further advance was made by Walter (1897), who sought to transmit half-tones. In 1904 Fortong combined this method with a form of intermediate *cliché*. In 1910 Stolfi and Bissiri made some practical experiments between Chicago and New York by a method similar in principle to Walter's.

When Prof. Heinrich Hertz, in 1887, at Karlsruhe, evolved his splendid experimental proof of the Maxwellian theory of light as an electromagnetic wave phenomenon it would have been indeed a wild dreamer who could have foretold even present-day uses of wireless telegraphy. But an inkling of the future crept out when, two years later, Elihu Thomson suggested that the Hertzian waves might prove valuable for *signaling* through fogs or material objects which could not be penetrated by the shorter waves of light. This idea of Hertzian wave telegraphy was not, however, productive of immediate results, for the inception of radiotelegraphy did not occur until six years later.

In 1890 Edouard Branly's investigations at Paris resulted in the production of delicate instruments which had the property of indicating the presence of Hertzian waves. These operated virtually by closing up the tiny gaps between particles of a pulverized metallic mass, upon the arrival of waves, and so thereafter received the name "coherer." A few years later, in England, Sir Oliver Lodge repeated the experiments of Hertz on a larger scale, using the coherer instead of Hertz's spark-gap resonator as a responding device. In this work fairly large distances, at least as compared to the earlier experiments, were traversed by the waves in passing from sender to receiver; it appears that the purpose was not telegraphy, however, but rather a further confirmation of Maxwell's theory.

In 1895, Prof. Popoff of Kronstadt, Russia, erected an apparatus for the purpose of observing lightning, and in so doing produced the nearest approach to a usable wireless telegraph receiver that had been built up to that time. Modifying the Branly coherer and combining with it a relay, recorder and tapping mechanism he secured a receiver which would mark upon a tape the time of each distant lightning flash. In addition, his apparatus would automatically prepare itself to record the next flash, by tapping the coherer gently and so breaking apart the particles which had been brought together in responding to the lightning discharge just received. Further, his arrangement included an elevated conductor for the purpose of collecting the energy of electromagnetic waves due to lightning, and a ground connection. It is interesting that an essential duplicate of this receiver as used twenty years ago is now utilized by one of the large power houses in New York to indicate the approach of thunderstorms and so to give warning that preparation must be made to meet an increased lighting load throughout the city.

The very next year, 1896, Guglielmo Marconi demonstrated in England the first real radio telegraph system which had ever been produced. By combining the Morse key with a more powerful form of Hertz transmitter, by perfecting the coherer of Branly, Lodge and Popoff, and by adding various new devices for protecting the instruments and preventing false operation, the pioneer invention was created. Although the various elements in rather crude form had been at hand for years, it required Marconi to correlate them so as to give the world an operable radiotelegraph. In the 1896 experimental messages were transmitted one and three quarter

miles across Salisbury Plain; early the next year the distance was increased to four miles, and soon, by using an earth connection with elevated aerial wires supported from kites and abandoning the parabolic reflectors, signaling was effected over nearly nine miles.

In 1897 Lodge began the application of his earlier work to actual wireless telegraphy, and on through 1898 produced a complete system which was characterized by excellent syntonization at both sender and receiver. By the insertion of inductance coils in the circuit between the elevated conductor and the earth he so greatly increased the persistence and definiteness of oscillation that sharp tuning of stations and consequently a considerable degree of freedom from interference was had. The same year, 1897, marked the entrance into the field of R. A. Fessenden, in the United States, and the beginning of the development of his system.

Fessenden's methods were especially notable because of his radical departures from the early art as practiced by Marconi. Instead of using the coherer, which was operated by the development of a single voltage, sufficiently great to cause partial amalgamation of the particles, Fessenden developed receivers in which the response was proportional to the total power being received from the transmitter at any instant. Again, instead of attempting to produce abrupt and rapidly decadent oscillations by sudden disruptive discharges of condensers, he directed his efforts toward more nearly or completely sustained waves, and even devised a method for their direct generation by means of a very high frequency alternator.

Marconi in 1898 worked out an arrangement of coupled circuits tuned to vibrate in unison both at sender and receiving station, and so made possible the transmission of large amounts of power without sacrificing sharpness of tuning. In this same year Ferdinand Braun, of Strassburg, Germany, worked out a somewhat similar arrangement for increasing power of radiation, but seems not to have included the essential of unison in vibration frequency of the various circuits.

The general trend of the art was toward erection of stations of higher output for signaling over greater distances; and on December 12th, 1901, Marconi succeeded in transmitting repetitions of the letter "S" (groups of three short impulses in the Morse code) across the Atlantic from Poldhu, in Cornwall; to St. John's, Newfoundland. About this same time activity and interest in wireless began to grow rapidly. Lee de Forest, in the United States, commenced work on arrangements of apparatus which were later embodied in the equipment supplied to many vessels and shore stations. Fessenden was continuing the evolution of his persistent and continuous wave systems, and devised many specific forms of transmitter and receiver which later came into wide use. The liquid barretter (electrolytic detector) is a product of this period.

In 1903, when Marconi was able to transmit actual messages entirely across the Atlantic at night, Valdemar Poulsen (the inventor of the telegraphone), in Denmark, devised a wireless transmitter comprising a direct current arc burning in hydrogen, which produced sustained waves and now forms the sending equipment of many powerful installations. It required about three years for the development of this arc oscillator to reach practicability; in the meantime, toward the end of 1905, Fessenden transmitted the first messages both ways between the United States and Great Britain, using his powerful musical toned spark stations near Boston and in Scotland.

In 1906 deForest commenced work on a development of the vacuum tube rectifier which Fleming applied to radiotelegraphy years before, and termed the new device an "audion." Outgrowths of this receiver are now proving useful as telephone amplifiers and very delicate wireless detectors, and are even used to produce waves for short distance transmission by radio. At Strassburg, Germany, during this period, Max Wien discovered some curious properties of transmitter circuits which were later involved in the Telefunken and Lepel impulse excitation systems.

In late 1907 Marconi opened a restricted public radio service between Glace Bay. Nova Scotia, and Clifden, Ireland, thus going into direct commercial competition with the Canadian cables for the first time. Less than a year later the Glace Bay "circuit" was offered for all classes of telegraph traffic, and it has remained in almost constant service since that time.

The first great life-saving feat to the credit of radio occurred on January 23rd, 1909, when the steamships "Republic" and "Florida" collided at sea. The "Republic" was able to secure assistance by wireless, and, though the vessel sank quickly, all her passengers were rescued. There have been many instances since then in which sinking or disabled ships have been able to gain help by sending out the radio distress signal, and the value of wireless equipment as insurance for vessels at sea has thus been clearly proved.

For the four years through 1914 radiotelegraphy had the normal growth of a young and valuable art; much progress in the detail of apparatus was made and a number of radical improvements brought forth. The Federal Government completed its powerful station at Arlington, Va., and worked in connection with the Eiffel Tower in a series of important experiments. The transatlantic stations at Tuckerton, N. J., and Hanover, Germany, nearly 4,000 miles apart, were put into communication early in 1914, so forming the first very long-distance link using the ingenious direct generation machines devised by Rudolf Goldschmidt. Transpacific commercial radio by the use of Poulsen arc generators has been in service several years, and last year a second wireless "line" between San Francisco and Honolulu was opened with Marconi spark transmitters.

The cutting of the German cable shortly after the opening of hostilities abroad last July gave a great impetus to transatlantic radio, and at this time both the Tuckerton-Hanover and Sayville-Berlin links are in operation. Various other uses of radio, such as the electrical location of enemy field wireless stations and communication with air vessels at moderately long distances, have been strongly emphasized by the war, and we may expect in the not distant future many additional and valuable applications of this interesting mode of conveying intelligence.

**The Development of Radiotelephony.**

The transmission of vocal sounds by wireless, in radiotelephony, has not yet become of commercial importance. This branch of the radio art originated in America something over ten years ago, at the time when the principles of producing sustained waves and modifying them by the use of telephone transmitters were brought forth. The three main problems of radiotelephony have been to generate uniform radio-frequency alternating current, to modulate it in accordance with speech waves, and to interlink wireless and wire telephones by means of suitable relays. Each of these difficulties has been overcome to some extent, and among those who have contributed largely to practical progress are Fessenden in the United States, Colin and Jeance in France, Poulsen in Denmark, Majorana in Italy, various engineers of the Telefunken system in Germany, and Marconi in England.

Although imperfections and limitations in methods and apparatus used have prevented widespread adoption of radiotelephony, much can be expected from this art in the future. When reliable apparatus capable of talking over 100 miles of sea at any time can be secured, it seems probable that the steamship service will find use for speech signaling. And when instruments are finally produced of such size and efficiency that spans of 1,000 miles or so can be covered regularly, it is not difficult to see how great will be the value of radio as a trunk link in long distance telephony. With wireless "lines" between cities, the voice may be transmitted over a distortionless ether system which need not be charged as an investment, for which no depreciation allowances are necessary, and which nature herself maintains constantly in perfect working order.

## The Patent Office and Invention Since 1845

(*Concluded from page 534.*)

shown by the large number of very important contributions she has devised in the last 35 years, and the increasing number of patents she has taken out in this country in recent years, now exceeding those applied for by any other foreign nation. To her sons is due the gas engine, the gasoline motor; the crude oil engine (Diesel motor); the automobile; the Welsbach lamp; the Tungsten lamp; the X-Ray machine; the utilization of blast furnace gases for operation of gas engines; the superheating of steam in locomotive practice, the synthesis of indigo; the contact method of making sulphuric acid, the Goldschmidt thermit process, and the innumerable and radical innovations in dye making, drugs, and chemicals.

An interesting confirmation of the changing character of our population may be made by comparing the names of inventors prominent in the earlier periods of the country's history with those which are found frequently scattered through the later additions of the Official Gazette. Fulton, Whittemore, Bigelow, Blanchard, Hoe, Campbell, Ames, Fairbanks, Howe, Colt, McCormick, etc., testify to the complete Anglo-Saxon predominance of former times, while such names as Bettendorf, Mergenthaler, Pupin, Tesla, Christensen, Doherty, Frasch, Gallagher, Conner, Monnot, Krakau, Mesta, Steinmetz, Sauveur, and Lindenthal, which are abundantly sprinkled among the names listed in recent Official Gazettes, offer proof of the leavening that is going on in all departments of American life.

## Converting Night Into Day

(*Concluded from page 536.*)

during the late seventies. We have already referred to the so-called "incandescence-arc" lamps, which mark the offshooting of the incandescent lamp from its parent stem, the arc. Numerous attempts, some of them involving much ingenuity, were made to produce a successful lamp of the "incandescence-arc" type, and much money was sunk in valueless patents, as Dredge's classic tome, "Electrical Illumination," containing records of all these early patents, abundantly testifies. One lamp of this sort was De Moleyn's. It comprised a glass globe with plugged openings for connection to a vacuum pump; into the upper part of the globe a tube containing finely powdered carbon was sealed; a movable copper wire ran through this tube and protruded through the orifice at its lower end (inside of the globe), this orifice being exactly large enough to let the carbon dust trickle through slowly, forming an "incandescence-arc" between the copper wire and a platinum spiral that came up through the bottom of the globe.

J. W. Starr of Cincinnati, Ohio (a *protégé* of George Peabody, the philanthropist), tackled in grim earnest the job of inventing a practical incandescent electric lamp, and his efforts resulted in the so-called Starr-King lamp, patented in 1845, when its inventor was only twenty-three years old. Two years later—in the very year, by a singular coincidence, that Edison was born—the ill-starred Starr had worked and worried himself to death; had he lived to complete his experimenting, the successful incandescent lamp might conceivably have been brought forth some thirty years sooner than it actually was. Starr's lamp had a Torricellian vacuum, the vacuous chamber, like that in a barometer tube, being formed by the inversion of a glass tube containing mercury; the "filament" consisted of a stick of retort carbon about one eighth inch square in cross-section. The lamp gave a good, bright light when new, but blackened rather quickly, and was further handicapped by the lack of a cheap, practical system of electricity supply.

Incidentally, we are told that the first electrolier for incandescent lamps was made by Pearce of Boston, about 1842, on George Peabody's order, and was used to interest capital in Starr's inventions. Electroliers were also shown in England by Starr and Faraday.

A period of comparative stagnation in electric-light development, relieved to be sure by Planté's invention of the storage-battery (1860), ensues for the next twenty-five years, but with the seventies the flood-tide of modern discovery sets in. In 1870, three years after Faraday's death, Z. T. Gramme received a patent on a really practical direct-current dynamo. In 1875 the Sprengel vacuum pump, which became almost immediately an important factor in solving the problem of successful incandescent lamp manufacture, was introduced. In the following year Lieut. Jablochkoff patented his famous "candle," consisting essentially of two vertical sticks of carbon separated by a thin fusible insulating barrier, across the top of which an electric arc played. The rated life of the various types of Jablochkoff candle, which worked on a voltage of about 42, varied from 1 hour and 20 minutes to 3 hours and 20 minutes. Thousands of these candles were sold, although comparatively few found their way to the United States, before they were driven out by the more modern arcs and incandescent lamps.

Meanwhile Charles F. Brush and Thomas A. Edison had applied themselves to the stupendous and hitherto unsolved problem of utilizing electricity for general lighting purposes. Brush exhibited his first arc lamp of the wonderfully simple and successful ring-clutch type in 1877, and in the next year produced that other indispensable feature of his system, the series arc dynamo, and started arc lighting campaigns all over the world. Four years later Brush arc lights, made in Cleveland, were in nightly operation in Shanghai and Tokyo.

The history of the arc seems incomplete without mentioning the early work of Elihu Thomson. He invented a generator, absolutely unique. In connection with it he developed the magnetic blowout, which has been extensively employed ever since in controlled, lightning arresters and circuit breakers. He also invented an arc lamp and regulator. Indeed, the Thomson-Houston and Brush arc systems were active competitors.

In 1879 several inventors were working on the incandescent lamp problem, among them Sawyer and Man, who experimented extensively with filaments of carbonized paper; Lane-Fox, who used vegetable fibers; Swan, who in February of that year publicly exhibited a lamp with a filament of parchmentized tread; Weston who worked even at that early date with squirted and cut nitrocellulose, and Edison, who tried out substances far too numerous to mention here, but including platinum, lamp-black, tar and paper. One might, perhaps, think that the failures of De Changy, De Moleyn, Starr, and others would have had a discouraging influence on these inventors in the late seventies, but they regarded them merely as lighthouses, showing what to avoid. Edison's famous exhibition of his complete incandescent lighting system, when the laboratory grounds were illuminated by seven hundred lamps, took place late in December, 1879, and attracted prominent visitors from all over the country. This may be considered the crowning, as it was the closing, event in the progress of illumination during the eighth decade.

Development during the years 1880 to 1889 was rapid and important. Lamp costs were brought down, as ways of simplifying and standardizing lamp parts were discovered. The price of arc light carbons was gradually reduced from $240 per thousand to about $10 per thousand. The art of "pasting" carbon filaments to the lead wires was discovered; previously, the filaments had to be attached by expensive mechanical devices, such as tiny bolts, nuts, washers, sleeves, and clamps.

The three-wire system of direct-current distribution was first put into commercial operation in 1883 at Sunbury, Pa. Who invented it is almost impossible to determine. Edison certainly developed it as part of his commercial system of incandescent lighting, and so did Edward Weston, long before, in the days when he first

used the dynamo in electroplating on a large scale. In 1866 Mr. George Westinghouse installed the first regular alternating-current central station in America at Buffalo, N. Y., and during the entire ten years under consideration the central station industry was rapidly extending its roots and branches. By 1890 electric lamps—incandescent and arc—had made their way into every civilized country.

The nineties, too, were prolific of discoveries. In 1891 the cellulose or "squirt" process of making carbon filaments was commercially introduced. Two years later the cellulose filament generally supplanted the bamboo. In 1895 came the "chemical exhaust" for incandescent lamps, which improved their average quality, at the same time reducing their cost, and was largely responsible for the reduction in price of carbon lamps in 1895 from 32½ cents to 20 cents each. Meanwhile the process of "treating" filaments in hydrocarbon vapor, rendering them more uniform and improving their radiating properties, had been introduced, although that, too, had been discovered very early by Edward Weston.

As experts and facilities for research multiplied, improvements, first of minor importance, but more recently of a revolutionary nature, were evolved. The substitution of molded bulbs for "free-blown" bulbs, about 1892, and the invention of the turn-down lamp by Phelps in 1898, belong, relatively speaking, in the category of minor improvements. The first indication to the world that the metal-filament lamp might eventually supersede the carbon came about 1898, when Dr. Welsbach produced his first osmium filament lamp. Curiously enough, tungsten had been tried for filaments as early as 1889 by Lodyguine and Tibbets, but unsuccessfully, as these workers did not realize the importance of having the metal extremely pure.

The mercury arc lamp was originated by Arons in 1892 and later developed to a point of greater commercial practicality by Cooper Hewitt.

The invention of the inclosed arc lamp in a practical form was announced at an electrical convention in 1894, when L. B. Marks described the first inclosed arc lamp embodying the points that made it, for a period of about ten years, the favorite unit for high candle-power lighting in America.

In 1899 the Bremer flame arc was announced, and in the following year Bremer exhibited at the Paris Exposition a model having four impregnated carbons, so arranged that the light produced was reflected downward. The modern "yellow-flamer," with carbons impregnated with calcium compounds, is an outgrowth of Bremer's lamp. Flame carbons giving light of various colors have also been developed, such as those containing salts of strontium, giving a pink light, or those of barium, which give a white light. The best-known of all the luminous arcs, however, is Steinmetz's invention, the "Magnetite," the electrodes of which are composed of metals and metallic oxides, without any carbon "body." It is essentially a direct-current lamp.

The discovery of ductile tantalum came from a German laboratory in 1901, and the first experimentally successful tantalum lamp was constructed a year or so later, although tantalum lamps were not in a condition to be placed on the market for several years more.

Meanwhile, in 1905, the "metallized" carbon lamp, in connection with which notable work was done by J. W. Howell in one of the laboratories of the largest American electrical manufacturer, made its appearance and served as a sort of stepping-stone to the lamps of still higher efficiency that were about to make their appearance.

In 1907 came the pressed-filament tungsten lamp, for which we are indebted in a great measure to two European inventors, Just and Hanaman. This lamp, under the hands of such men as Dr. W. D. Coolidge, Dr. A. Pacz, and a host of other experts, has gradually evolved into the strong, durable, cheap drawn-wire lamp of to-day.

The very newest line of development, due in the first place largely to Langmuir and Orange, working under the direction of Dr. W. R. Whitney in the Research Laboratory of the General Electric Company, has given us non-vacuum incandescent lamps with efficiencies deemed utterly impossible a few years ago. Some of these big lamps, the bulbs of which are filled with inert gases, actually take less than half a watt per candle. They are giving the arc lamps, particularly of the old open and inclosed types, a hard race just at present.

Although there have been wonderful accomplishments in arc and incandescent lighting during the past century, yet we all share more or less the attitude of Mr. Edison, who, in the course of a conversation with the writer, remarked: "I don't like to go into things connected with ancient history, or the dead past—what I am interested in is the future; in what is going to happen to-morrow." And assuredly there is much to be done. Scientists find that the most efficient arc and incandescent lamps of to-day waste something like 85 per cent of their incident energy in other forms than light—from an efficiency standpoint they are outshone by the common firefly. So the curtain of mystery still veils the lamps of our descendants.

## Some Personal Recollections

(*Concluded from page 537.*)

a lightning flash. In an instant I saw it all, and I drew with a stick on the sand the diagrams which were illustrated in my fundamental patents of May, 1888, and which Szigety understood perfectly.

It is extremely difficult for me to put this experience before the reader in its true light and significance for it is so altogether extraordinary. When an idea presents itself it is, as a rule, crude and imperfect. Birth, growth and development are phases normal and natural. It was different with my invention. In the very moment I became conscious of it. I saw it fully developed and perfected. Then again, a theory, however plausible, must usually be confirmed by experiment. Not so the one I had formulated. It was being daily demonstrated every dynamo and motor was absolute proof of its soundness. The effect on me was indescribable. My imaginings were equivalent to realities. I had carried out what I had undertaken and pictured myself achieving wealth and fame. But more than all this was to me the revelation that I was an inventor. This was the one thing I wanted to be. Archimedes was my ideal. I admired the works of artists, but to my mind, they were only shadows and semblances. The inventor, I thought, gives to the world creations which are palpable, which live and work.

The telephone installation was now completed and in the spring of 1882 an offer was made me to go to Paris, which I accepted eagerly. Here I met a number of Americans whom I befriended and to whom I talked of my invention, and one of them, Mr. D. Cunningham, proposed to form a company for exploitation. This might have been done had not my duties called me to Strasburg, Alsace. It was in this city that I constructed my first motor. I had brought some material from Paris, and a disk of iron with bearings was made for me in a mechanical shop close to the railroad station in which I was installing the light and power plant. It was a crude apparatus, but afforded me the supreme satisfaction of seeing, for the first time, rotation affected by alternating currents without commutator. I repeated the experiment with my assistant twice in the summer of 1883. My intercourse with Americans had directed my attention to the practical introduction and I endeavored to secure capital, but was unsuccessful in this attempt and returned to Paris early in 1884. Here, too, I made several ineffectual efforts, and finally resolved to go to America, where I arrived in the summer of 1884. By a previous understanding I entered the Edison Machine Works, where I undertook the design of dynamos and motors. For nine months my regular hours were from 10:30 A. M. till 5 A. M. the next day. All this time I was getting

more and more anxious about the invention and was making up my mind to place it before Edison. I still remember an odd incident in this connection. One day in the latter part of 1884 Mr. Bachelor, the manager of the works, took me to Coney Island, where we met Edison in company with his former wife. The moment that I was waiting for was propitious, and I was just about to speak, when a horrible looking tramp took hold of Edison and drew him away, preventing me from carrying out my intention. Early in 1885 people approached me with a proposition to develop an arc light system and to form a company under my name. I signed the contract, and a year and a half later I was free and in a position to devote myself to the practical development of my discovery. I found financial support, and in April, 1887, a company was organized for the purpose, and what has followed since is well known.

A few words should be said in regard to the various claims for anticipation which were made upon the issuance of my patents in 1888, and in numerous suits conducted subsequently. There were three contestants for the honor, Ferraris, Schallenberger and Cabanellas. All three succumbed to grief. The opponents of my patents advanced the Ferraris claim very strongly, but any one who will peruse his little Italian pamphlet, which appeared in the spring of 1888, and compare it with the patent record filed by me seven months before, and with my paper before the American Institute of Electrical Engineers, will have no difficulty in reaching a conclusion. Irrespective of being behind me in time, Prof. Ferraris's publication concerned only my split-phase motor, and in an application for a patent by him priority was awarded to me. He never suggested any of the essential practical features which constitute my system, and in regard to the split-phase motor he was very decided in his opinion that it was of no value. Both Ferraris and Schallenberger discovered the rotation accidentally while working with a Gaullard and Gibbs transformer, and had difficulty in explaining the actions. Neither of them produced a rotating field motor like mine, nor were their theories the same as my own. As to Cabanellas, the only reason for his claim is an abandoned and defective technical document. Some over-zealous friends have interpreted a United States patent granted to Bradley as a contemporary record, but there is no foundation whatever for such a claim. The original application only described a generator with two circuits which were provided for the sole purpose of increasing the output. There was not much novelty in the idea, since a number of such machines existed at that time. To say that these machines were anticipations of my rotary transformer is wholly unjustified. They might have served as one of the elements in my system of transformation, but were nothing more than dynamos with two circuits constructed with other ends in view and in utter ignorance of the new and wonderful phenomena revealed through my discovery.

## The Development of the Dye Industry

By M. L. Crossley, Sc.M., Ph.D., Associate Professor of Chemistry and Acting Head of the Department, Wesleyan University, Middletown, Conn.

At this time when the entire public is in a feverish excitement over our newly realized dependence upon Germany for dyes and organic chemicals it is not amiss to call attention to the marvelous triumphs of chemists in the development of the dye industry. In spite of the fact that in our enormous coke production we have almost an unlimited supply of by-products suitable for the manufacture of dyes and organic chemicals, this industry has not made much progress in this country. This is not because of any inferiority on the part of American chemists to solve problems of this type, but rather, because circumstances have been more favorable for the development of other industries in America. The thorough organization of the dye industry abroad, backed by government support, made it impossible for our

manufacturers to compete on a satisfactory basis.

The dye industry is by no means new. From the dawn of human intelligence the desire for adornment which could rival nature in beauty and variety of color has been evident. It is not improbable that Eve herself was impressed with the splendor of Mother Earth's marvelously beautiful colored garb and selected her own first cellulose gown after the same pattern. As far back in Antiquity as we can pierce we find evidence of colored fabrics having been worn and it is quite certain that the art of dyeing was practised by the Ancients with some skill and with no little pride. Wrappings of the mummies found in the tombs of Thebes, estimated to have been in use 4000 B. C., bear witness to the fact that indigo was used to dye muslin of unusually fine quality. Evidence of the continued use and appreciation of dyes by the ancients is not wanting. The book of Leviticus, supposedly written 1490 B. C., chapter 13, lends support to this view when it records the use of textile fabrics of beauty and strength. In the book of Genesis, written probably about 1723 B. C., we read, chapter 37, 31, "Now Israel loved Joseph more than all his children, because he was the son of his old age; and he made him a coat of many colors." Evidently a coat of many colors was a garment highly prized and therefore appropriate for the expression of Israel's love. Blue, purple, scarlet, and red seemed the popular colors. The book of Exodus, chapters 25, 26, 27 and 28, describes the specifications of the tabernacle which the Lord commanded Moses to build and therein it is prescribed that the tabernacle must have "ten curtains of fine twined linen, and blue, and purple, and scarlet with loops of blue," that the tent must have a covering of "ram's skin dyed red;" that there be provided a "veil of blue, and purple, and scarlet." That the tent have "an hanging for the door of blue, and purple and scarlet;" and also that "the gate of the court have an hanging of 20 cubits of blue, and purple, and scarlet." Frequent other references may be cited to show that, at least, the colors, blue, red, purple, and scarlet, were familiar to the ancients. The writings of Homer, Theophrastus, Discorides and the elder Pliny lead us to suspect that the art of dyeing was first practised by the Indians and that from them the Phoenicians acquired it and transferred it to the Egyptians from whom the Hebrews learned it. It is quite certain that the Egyptians practised the art of dyeing as early as 2500 B. C. The Chinese seem also to have prepared certain dyes and used them to dye silk at a very early period.

The popular demand for colored clothes has continued throughout the ages and come down to us as a genuine inheritance. To the Roman love for conquest we owe much for the freedom of the art of dyeing from the mysticism and secrecy of the East and for its dissemination throughout Europe. Rome was schooled in the art by the Jews and unintentionally passed it on to the peoples whom she conquered. Colors played no little part in the social and religious life of the people. Purple, in particular, was highly esteemed and set apart for the distinction of nobility. One writer says: "It is for this color the fasces and axes of Rome make way in the crowd; it is this that distinguishes the Senator from the man of equestrian rank; by persons arrayed in this color are prayers addressed to propitiate the gods; in every garment it sheds a luster, and in the triumphal vestment it is to be seen mingled with gold." Pliny is also authority for the information that this color was prized highly by the Romans. He says, "Pearls may be looked upon merely as an everlasting possession; of everlasting duration; they descend from man to man, and they are alienated from one to another just like landed estate, but the colors which are extracted from the Murex and Purpura fade from hour to hour, and yet luxury which had similarly acted as a mother to them has set upon them prices almost equal to those of pearls." The Murex and Purpura referred to are species of molluscs from which the purple dye used by the Romans was extracted, it requiring 12,000 molluscs to give 1.4 grammes of dye. The water of Tyre was

famous for Murex and the dye was called Tyrian Purple. Cloth dyed with Tyrian Purple was extremely expensive. According to one writer of the first century, a pound of twice-dyed Tyrian Purple could not be purchased for less than 1,000 denarii or approximately $170 in American money.

The first period in the evolution of the dye industry witnessed chiefly the development of the art of applying natural dyes of animal and vegetable origin to different fibers. The ancients made woven fabrics of wool, silk, linen, and cotton with a considerable degree of perfection. On these they endeavored to imitate the beauty of nature with the coloring matter of certain herbs, roots, stems of plants, bark of trees, seed, berries, nuts, lichens, blood of shell-fish, etc. Their methods of dyeing involved practically no understanding of chemistry. A dyer was an artisan and not a chemist. Much dye was wasted in the dyeing processes and it was practically impossible for even the most skilled dyer to exactly duplicate a color. The same dye gave several different results on a similar fiber.

Throughout Europe the industry developed rapidly, contributing in many cases to the social well-being and economic progress of the people. Color continued to be a recognized mark of class distinction. The Flemish people became adept in the art of applying dyes and are credited with developing it in England, Scotland, and Ireland.

Natural dyes were extensively prepared and used. The cultivation of madder and indigo was an important business down to the latter part of the nineteenth century when alizarin and indigo were synthesized and introduced on the market in competition with the natural products. In 1868 France produced over eight million dollars worth of madder. Eight years later the production ceased. Natural indigo was not quite so easily disposed of. Its production, however, reached its maximum in the year 1896-1897, when there were 640,000 hectares (1,581,440 acres) under cultivation. The yearly consumption of indigo was about twelve million pounds. Since 1900, synthetic indigo has practically displaced the natural product.

The second period in the development of the dye industry began with Woulfe's discovery of picric acid in 1771. This was a glimpse into a new world of thought and activity and consequently we should not be surprised to find that further discoveries of great importance did not immediately follow. Woulfe's process for the production of picric acid, by the oxidation of indigo with nitric acid, was too expensive to be used commercially and picric acid was not satisfactorily produced until many years later, when it was discovered that it could be obtained cheaply by the nitration of phenol, a coal tar product. Woulfe's discovery, however, stimulated other chemists to work on indigo in an attempt to find out its composition—the most important of the early work being that of Chevreul in 1810; that of Erdmann and Laurent in 1841; and that of Erdmann in 1842. As a result of this pioneer work, isatin was obtained from indigo. This discovery pointed to the possible relation between the indigo molecule and that of isatin and was an important contributing factor in all the later synthesis of indigo. The impetus to investigation of the nature of dyes had been given and, as a natural consequence, the activity in the dye industry shifted from the art of extracting and applying natural dyes to the study of the scientific principles involved in the production and application of synthetic dyes. The synthesis of dyes was a great triumph over nature and opened up an attractive field of research.

In praising the men who actually synthesized dyes, we must not overlook the work of the pioneers in chemical analysis who made the discoveries possible. By careful analysis of natural substances, they led the way to the unraveling of Nature's secrets in building them up and thus introduced to their successors a world of extremely fascinating and highly profitable work.

In 1856, Perkin discovered mauvine, the synthesis of which was of great importance in shaping the course of the development

of the synthetic-dye industry. This was manufactured on an industrial scale the year following its discovery and it immediately became a commodity in great demand. Chance happened to play a considerable part in Perkin's discovery, consequently, exact scientific methods did not receive just recognition at the time and the youthful synthetic-dye industry began life in England without the support of pure science. This is a very important fact and partially explains why the new industry found German soil more conducive to its full development.

Like England, France was also a pioneer in the manufacture of synthetic dyes, but she gradually lost her grip on the industry, in competition with Germany, because of her inability to withstand the German organization; because of her careless neglect of pure science in connection with the manufacture of synthetic dyes; and because of the initial struggle of the synthetic dyes to overcome public prejudice in France where the natural dyes were available. French capital was interested largely in the production of natural dyes and consequently it did not see clearly the potentialities of the new phase of the dye industry.

The triumphs in the chemistry of dyes during the past fifty years have been nothing short of marvelous. Perkin's discovery of mauvine stimulated research on the oxidation of aniline with different reagents and led to Verguin's discovery that tin chloride would convert crude aniline into magenta (Fuchsine). In 1860, Nicolson, Girard and de Laire worked out a satisfactory method of preparing magenta on a commercial basis and thus made possible the production of a wider range of colors with synthetic dyes. In the same year, they produced rosaniline blue, the first synthetic blue dye, by treating magenta with aniline. In the following year Lauth synthesized methyl violet and Nicolson made chrysaniline. In 1862 Nicolson made another contribution to science in the discovery of water blue, or the sodium sulphonate of rosaniline. In the same year, Cherpin discovered aldehyde green, the first green synthetic dye, and Lightfoot prepared aniline black—a dye of great importance even to-day. About 1865, Kekulé proposed his theory of the structure of the benzene molecule and exact investigations in dye chemistry received a very noticeable impetus, especially in Germany. Three years later, Graebe and Liebermann and Perkin independently synthesized alizarin, the chief dye of madder. This was one of the greatest achievements of pure science. Of no less importance was the struggle of this synthetic dye to displace madder. It was only after years of careful and systematic research to establish the best and most efficient methods of applying this dye that it finally triumphed over the natural product.

After twenty years of costly research synthetic indigo was made possible. This product was far superior to the natural substance and this fact helped it in its struggle against public prejudice. Many chemists contributed to the solution of the synthetic indigo problem. Baeyer, Drewson, and Heumann should receive special mention for their brilliant contributions. No one of the chemists who worked on this problem could have solved it without financial support. The Badische Aniline and Soda-Fabrik spent over one hundred thousand dollars in developing Baeyer's patents without reward. It was only after the discovery that napthalene could be used as an initial substance in the manufacture of indigo that it was able to compete with the natural product. To-day, synthetic indigo and its derivatives are indispensable in the textile industry. The beautiful Tyrian Purple was found by Friedlander to be 2:6-dibromindigo. It is not necessary now to secure it from the blood of shellfish at an enormous cost. It can be manufactured from napthalene in large quantities.

There are nine hundred or more synthetic dyes on the market to-day and everyone of them has meant a new triumph for chemical science. The combined efforts of Kekulé, Witt, Peter Griess, Caro, Martius and Rousseu made possible the development of the Azo dyes which repre-

sent over 50 per cent of the dyes in common use. Finally, the Vat dyes have been discovered during the past fifteen years and extremely fast, brilliant colors can now be produced.

The greatest and most important part of this activity has been confined to Germany where the dye industry seemed to find conditions most favorable for its unrestricted development. Kekulé's theory of valence was easily assimilated by the German chemists and immediately they calmed their doubts and substituted exact methods of research for mere philosophical speculation. Pure science was selected as the foundation upon which to build the dye industry. Time has shown this to have been wise.

The German chemists' faith in the ultimate success of the application of theoretical chemistry to practical problems and their absolute certainty inspired the confidence of capital to venture the support of the promising infant industry without the assurance of immediate returns on its investment. Of course, it must not be supposed that either extraordinary foresight or generosity was responsible for the eager willingness of German capital to lend a protecting arm to this new industry. Careful analysis of the situation reveals the fact that it was international business rivalry which prompted the investments and patiently supported the project, calmly awaiting the fruition of its potential promises. Natural dyes were chiefly in the control of England and France. Germany saw a chance to displace their dyes by better products, whose properties could be guaranteed to be always the same, and thus win over the business. Theory and practice were solidly allied together to win success, even at heavy initial costs, and a systematic and thorough organization of work resulted. To organized co-operative research, Germany owes much of her success in the dye industry. The research laboratory has been an indispensable unit in her factory equipment. It has been the nucleus and its importance has been thoroughly recognized. Eminent chemists have directed its work and caused its influence to be favorably felt and genuinely appreciated. Masses of information needed in the development of an industry so complex and diversified have been compiled with the least possible expenditure of energy and money and made available for the use of the productive part of the factory. The soundness and value of such a systematic scientific foundation has been unquestionably demonstrated.

Not only has the German manufacturer of dyes been successful in enlisting an army of thoroughly trained chemists and technologists to solve his problems, but he has also learnt how to use labor so as to get its greatest efficiency and at the same time engender in it a spirit of contentment. The splendid way that employees are treated by the large German dye manufacturers speaks volumes for the friendly spirit of co-operation between labor and capital and ultimately is a large contributing factor to the success of the industry.

Here in America we might take note of the factors involved in the German success in the development of the dye industry before undertaking to transplant it to our soil, realizing that "rule-of-thumb" methods can never be productive of genuine permanent results in this field and that to satisfactorily meet the competition of the German organization we must establish the industry on a thoroughly scientific basis. We should expect keen competition when the war is over, but in spite of this an American dye industry should survive if organized on the principles which have led to the German supremacy in the tinctorial world.

### The Rise of the Motorcycle

THE first practicable motorcycles in this country were used for the purpose of pacemakers in bicycle races and the first machines made for general purposes were adaptations of the bicycle fitted with racing motors. All motors which have proved so far successful have been of the internal combustion type, using gasoline altogether. The electric and steam driven engines proved to be too heavy for successful adaptation. The power plant had no defi-

nite location at first, being placed on some models in the seat post of the diamond frame taken over from the bicycle, and the tank for fuel and oil was commonly suspended on the mudguard over the rear wheel.

In successive years, however, the diamond frame has given way to a modified loop frame and the engine has been located in the loop, the motor base or crankcase taking the place of the old crank hanger of the bicycle and the tank for gasoline and oil being fastened above it. The frame is made of forged steel, which is heavier than formerly, the joints brazed electrically or by the oxy-acetylene method of welding, contributing to long life and wear. A motorcycle nowadays is of either the single or two-cylinder type, ranging in power from 3½ to 7, 8 and 10 horsepower, with some variations to four-cylinder machines.

The power control is from the grips, one of the grips controlling the compression and the electric spark and the other the throttle, which regulates the supply of gas to the combustion chamber. This gives the rider of the American machine more effective control than on the foreign makes, where there is a confusing multiplicity of levers to regulate the speed of the engine. On some American machines there is a hand brake operating a contracting band brake on the rear hub, and in addition an internal expanding brake which may be operated by the foot. On the newer models the rider's hand finds within easy reach levers to control the gear shift and thus secure change of speed, and other levers to throw in or release the engine clutch.

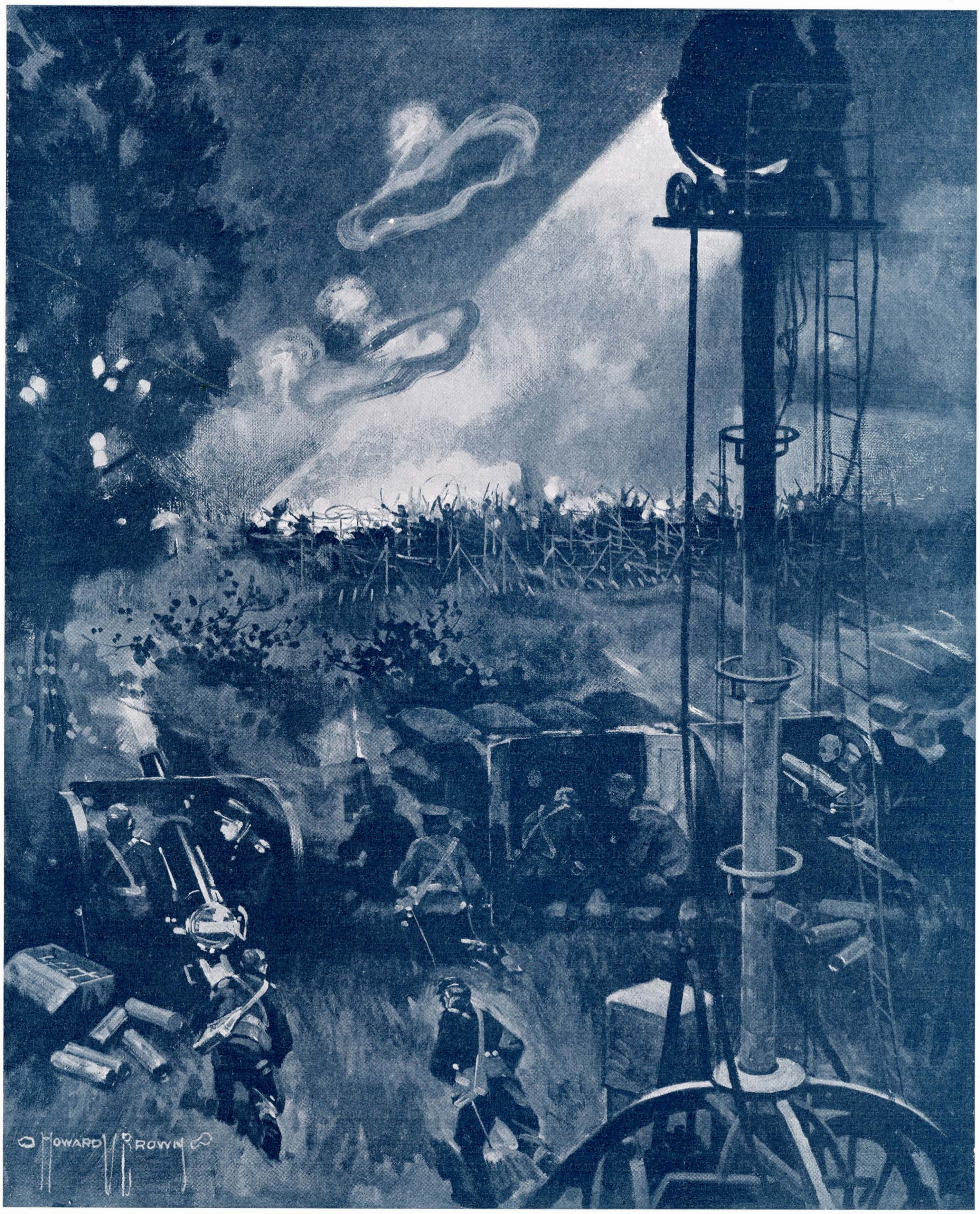
The transmission from the engine to the hub of the rear wheel is commonly by means of two drive chains, from engine shaft to countershaft, which carries the gearset, and thence to the sprocket of the rear wheel. A few models maintain the belt drive, with idler pulley. The engine is thrown into engagement with the driving mechanism by means of a clutch, which is either of the multiple friction disk, cone or band type. The gasoline motors have been so improved and start with such quickness and reliability that the pedals, which were first employed to get the engine going and to give assistance on the hills, have now been discarded in favor of a kick or step starter, the driver being provided with footrests which are brazed on the frame. All machines now carry a rear stand on which they may be supported, when not in use.

Prominent among improvements of recent years are the cradle spring frame, consisting of leaf springs fitted in the fork and rear structure of the frame, which take the weight of the engine and rider and make the machine easy riding on hard roads. Electrical equipment is another feature, a magneto generator which is driven by the engine furnishing the electric spark for ignition of the gas in the motor and current for lighting headlight and rear lamp, besides charging a battery.

It is estimated that there are in use in this country 180,000 registered motorcycles. A Government report gives California, where weather conditions permit riding the year around, as the first State in the number of enrollments, having 24,709 in 1914; New York second, with an estimated total of 24,000 machines; Ohio third, with 20,637 machines registered, and Illinois fourth, with a total of 14,852. Then follow Pennsylvania, with 14,592; Indiana, 10,403; New Jersey, 10,029; Kansas, 8,068; Massachusetts, 8,161; Iowa, 7,318; Wisconsin, 7,880; Michigan, 7,000; Washington, 4,000; Colorado, 3,863; and so on through the list, the registration ranging between 1,000 and 3,000 per State.

The fastest time ever made on a motorcycle was a mile in 36 seconds. It has frequently been driven at speeds of 80 and 90 miles an hour in races and has maintained an average of more than 60 miles in many long-distance races. In a transcontinental trip from San Diego, Cal., to New York city in 1914 a motorcycle covered 3,378.9 miles in 11 days 12 hours 10 minutes, Erwin G. Baker riding it throughout the trip.

# SCIENTIFIC AMERICAN




USING THE SEARCHLIGHT TO REPEL A NIGHT ATTACK.

Vol. CXII. No. 24
June 12, 1915

Munn & Co., Inc., Publishers
New York, N. Y.

Price 10 Cents
$3.00 A Year

# SCIENTIFIC AMERICAN

**Founded 1845**

**NEW YORK, SATURDAY, JUNE 12, 1915**

Published by Munn & Co., Incorporated. Charles Allen Munn, President; Frederick Converse Beach, Secretary; Orson D. Munn, Treasurer; all at 233 Broadway, New York.

Entered at the Post Office of New York, N. Y., as Second Class Matter
Entered as Second Class Matter at the Post Office Department, Canada.
Trade Mark Registered in the United States Patent Office




**Subscription Rates**

| | |
|---|---|
| Subscription one year | $3.00 |
| Postage prepaid in United States and possessions, Mexico, Cuba, and Panama. | |
| Subscriptions for Foreign Countries, one year, postage prepaid, | 4.50 |
| Subscriptions for Canada, one year, postage prepaid | 3.75 |

**The Scientific American Publications**

| | | |
|---|---|---|
| Scientific American (established 1845) | per year | $3.00 |
| Scientific American Supplement (established 1876) | " " | 5.00 |
| American Homes and Gardens | " " | 3.00 |

The combined subscription rates and rates to foreign countries including Canada, will be furnished upon application.

Remit by postal or express money order, bank draft or check.

**Munn & Co., Inc., 233 Broadway, New York**

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp* the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.


*The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.*

## Some Thoughts On the War

At a time when the war is assuming more gigantic proportions, it seems almost idle to speak of Peace. Nevertheless, the problem naturally presents itself, how and when could the conclusion of peace be considered as a possibility. One of the most discouraging features of this world war is the fact that when this war broke out the nations of Europe fought, not to adjust or settle any profound principle of right or wrong, not to adjust some grievance, not surely for the love of fighting, but in obedience, it would seem, to some perverse fate. There surely had been no well defined and commonly accepted issue; the reasons given were as varied as the nations engaged. In case some visitor had appeared from a neighboring planet, it would be easy to imagine his utter amazement at the sight of the warring nations killing each other, destroying each other's cities and homes and engaged in mutual murder and devastation; but his astonishment at this would have been nothing as compared with his state of mind when he discovered the inability of the combatants themselves to explain just why they were fighting.

The war broke out suddenly without any preliminaries; there had been no act of aggression, no hard words had passed, and as between most of the warring nations there had been even no diplomatic disagreements. In short, the war came out of a clear sky, without meaning, without principle, with no just cause, and with no wrong to adjust. It is this lack of justifiable cause for war that renders the hope of peace so remote. There is no primary wrong to adjust, there is nothing to arbitrate. So upon what grounds could peace be effected?

The present offers a proper time to consider what the ten months of horror have achieved. The record shows a vast preponderance of advantage in favor of the Teuton Allies. Germany holds the greater part of Belgium, a fair portion of France, a large part of Poland. The Fatherland is thus far intact and may prove to be impregnable. In case, with the increasing strength of the Allies, and in view of the settled policy of Germany, which has been turning the neutrals of all nations into avowed or unavowed hostility, the tide should turn (as it surely must) what can the result be? Will there follow a higher and better order of things? What will the Europe of to-morrow be like? The flower of manhood in Europe is being destroyed by the thousands and tens of thousands, the land is being laid waste, whole peoples are dying of want and hunger, the destruction of material wealth is going on at an unprecedented rate. The national debt of the warring nations is reaching untold sums. The bills must be paid, not only by the present, but by future generations. Will not the burden be too great for the people to bear? The future of Europe seems dark indeed. Although the material destruction that has already taken place is figured coldly in the newspapers in millions and billions of dollars, and has involved the complete wiping out of some of the most beautiful cities of Europe, this may prove to be but the beginning; for there is ever growing evidence that the war is to be a protracted one.

This material loss, enormous and ever increasing, is not the only or even the saddest burden of the war. Equally appalling is the moral cataclysm which has taken place—the loss of faith in human nature, the breakdown in the sacredness of treaties and contracts, the race hatred that has been engendered, the overturning of ideals, and the setback to the advancement of civilization. How changed would be the conditions if the war were being waged for high principles from which some lesson of right or wrong might be learned. It might then be hoped that some basis might be reached for the establishment of a permanent peace. It seems, however, that this cannot now be done except through the sad and awful expedient of the complete exhaustion and subjection of one or the other of the warring nations. Will the nations of the future, the new nations that must be born out of the ashes of the present terrible struggle, hold to a simpler creed and a higher diplomacy, substituting the new diplomacy of truth for that of deception? Will they have higher ideals of human faith and responsibility? Shall we witness the birth of a new era, in which will be found a greater belief in, a higher regard for and a more human sympathy with one's neighbor, even though he be of foreign blood? Perhaps, when the great bitterness of the struggle is over and the waste and futility and sin of it all are understood, some such readjustment of the world's ideals may follow.

## When the German Fleet Comes Out

The forlorn hope has no part in the scheme of German tactics either on sea or land. Even when she has hurled her men in masses against seemingly impregnable positions, we may rest assured that her generals have believed that the chances of success were good. As on the land, so on the sea. We may rest assured that Von Tirpitz will never send out the German main fleet for a trial of strength with the British except under conditions which afford a reasonable promise of success.

As matters stand to-day, the German first fighting line includes probably seventeen dreadnoughts; against this force Great Britain could oppose to-day, including ships commissioned since the war began, thirty-eight dreadnoughts. In point of numbers of ships, this means a superiority of over two to one; but if we take into consideration the heavier batteries and higher speed of the later British ships, the actual fighting superiority is about three to one.

As to the future, it is certain that the longer the war lasts the greater will be the British advantage; for under the accelerated rate of construction, she is adding to her main fleet at the rate of over one dreadnought per month.

Is the German main fleet, then, destined to spend the long years of this war condemned to hopeless inactivity within its own harbors and roadsteads? We doubt it. On the contrary, we believe that, when the readjusted plans of the German Admiralty are ripe for prosecution, the German fleet will issue forth in full force for a great trial of strength along those strategical and tactical lines which, under the present naval conditions in the North Sea, alone can offer her any chance of victory.

The proposed scheme of German naval operations prior to the war was to reduce the British battleship strength by ceaseless destroyer and submarine attacks, and when this process of attrition had reached the desired point to issue forth for a line-of-battle engagement. So far as the German destroyers are concerned, the results have been practically *nil;* the submarine, on the other hand, in the early stages of the war and before the British had learned by experience how to meet this form of attack, scored some very notable successes. For several months, however, at least in the North Sea and around the British Islands, submarine activity against the fighting fleet has produced no recorded results. Failing against their legitimate prey, the German submarines turned savagely upon the unarmed merchantmen of the enemy.

We offer it as a plausible, if not a probable theory, that the German tactics, when the great sea fight comes off, were foreshadowed in the operations of the German battle-cruiser fleet a few months ago in the North Sea. We believe that the raiding of undefended towns on the east coast of England was not so much an exhibition of what has been termed German "frightfulness" as it was the preliminary stage of a German strategy, which was designed to draw the British fleet into action and lead it in a stern chase into waters where flotillas of German submarines awaited its coming. This theory would explain two very remarkable facts which certainly seem to require explanation, connected with that running fight across the North Sea. The first of these was the complete abandonment, by the powerful German armored battle-cruisers, of the unfortunate "Bluecher," whose destruction was certain as soon as they drew away from her. The other, and more astonishing fact, is that after the flagship "Lion" had been put out of action by a shot in her engine room, and the odds, so far as the ships engaged were concerned, were three German to two British ships, the Germans, with an advantage of twenty-eight armor-piercing guns against only sixteen on the two British cruisers, failed to close in and attempt to sink the enemy with an overwhelming superiority of gunfire.

For it should be noted that the 29-knot battle-cruisers, "Doerflinger," "Seydlitz," and "Moltke," "Princess Royal" and "Tiger," had pulled out far ahead of the slower "Bluecher," "New Zealand," and "Indomitable." When the "Lion" was disabled, therefore, these German battle-cruisers were able to oppose eight 50-caliber 12-inch and twenty 50-caliber 11-inch armor-piercing guns to the sixteen 13.5-inch armor-piercing guns carried by the two British ships. If the Germans had immediately closed in to nine or ten thousand yards, their guns would have been able to penetrate the 9-inch belt armor of the British ships with ease; and with a superiority of twenty-eight guns to sixteen, and anything like equal shooting, the result would have been a foregone conclusion.

Why did not the German admiral seize such a tempting opportunity? Certainly not from fear of the British fire—that has never been a German characteristic. We are inclined to believe that, in continuing his flight, the German admiral was acting under strict orders and according to a predetermined plan, which was to lead the British fleet into waters where a flotilla, or perhaps several flotillas, of German submarines were gathered. That this was the plan is suggested by the fact that the British ships did run up to a group of submarines, and indeed came so near to running through them, that Admiral Beatty from the bridge of the "Princess Royal" saw the streak of an approaching torpedo, and only by a quick turn of the helm avoided it.

It is possible and, to our minds, rather probable, that the German Admiralty, realizing the hopelessness of any attempt to gain equal strength with the British in capital ships, is devoting the whole of the country's shipbuilding strength to the construction of submarines of the greatest size, speed, radius of action, and torpedo-carrying capacity. At the opening of the war, Germany probably did not have over twenty-five submarines in commission. If, early in the war, she ceased the construction of capital ships and devoted her whole energy to the construction of a vast submarine fleet, it is possible that she may have over a hundred of these craft to-day in commission, and this in spite of her many losses. It is conceivable she may have another hundred or even more under construction. Undoubtedly as fast as they are completed and the crews can be found, the new boats are put into commission. It cannot be disputed that the work of hunting down and sinking the merchant ships of the enemy affords the German submarine fleet every opportunity to become proficient in maneuvering and torpedo practice.

Now, if this be the German plan, it can be seen at once that the military value, in the way of training the crews and the shaking down of the submarines into thoroughly serviceable condition, which is involved in this far-flung series of operations directed against merchant ships, is of far more value to Germany than the mere loss by the enemy of 2 or 3 or even 5 per cent of his merchant fleet.

When Germany feels that her submarine fleet is sufficiently numerous and its *personnel* fully efficient for the prosecution of her long-deferred offensive, we may look for a general calling in of the raiders to the home ports, and a sudden cessation of the sinking of merchant ships. Whenever that occurs, it will be reasonable to watch for the exit of the whole German fleet in full strength to seek and get in contact with the enemy. Contact once secured, we may expect a repetition on a grand scale of the tactics employed in the recent battle-cruiser engagement. There will, conceivably, be a pretended flight of the German fleet from superior forces and an attempt to lead Admiral Jellicoe and the fighting forces under his command into a veritable shoal of submarines.

Should the German ruse prove successful, and the British destroyers fail to locate the submarines and give timely warning, it is conceivable that within a short time after it ran into the snare, 50 per cent of the British fleet would be out of action. Admiral Jellicoe and his staff, however, are perfectly familiar with all the possibilities above suggested; and it is conceivable that, in spite of his enormous superiority in strength, he might refuse to follow the German lead.

Some day, and under conditions which suit themselves, the Germans will come out into the North Sea in full strength; and when that happens the world will witness a series of maneuvers and a great battle or series of battles which, in point of interest, novelty of conditions, and frightful destructiveness, will set a new mark in the history of naval warfare.

## Science

**The Scientific Survey of Porto Rico,** under the auspices of the New York Academy of Sciences in collaboration with the American Museum of Natural History and other institutions, is now in its second year. A second annual appropriation of five thousand dollars toward its expenses has been made by the Porto Rican government.

**Photographic Measurements of Ocean Waves** are to be made by Profs. Penck and Laas with the aid of funds provided by the Berlin Academy of Sciences. More definite information than has heretofore been available regarding the shapes and dimensions of waves is a desideratum felt in ship-building, harbor construction, and coast protection.

**An Institution for Ethnological Research** modeled largely after the Bureau of American Ethnology in Washington, has recently been founded in Leipzig with the aid of funds furnished in part by the government and in part by Prof. Hans Meyer. According to the description of the new institution published in *Petermann's Mitteilungen*, it represents the realization of a plan proposed years ago by the celebrated traveler and ethnologist Adolph Bastian.

**The Most Remarkable Photograph of a Meteor Trail** that has yet been taken, so far as we know, is reproduced in *L'Astronomie* for March, 1915. The meteor in question was seen from many points in South Africa about 5 P. M. on June 2, 1912—i. e., in broad daylight—and the trail that it left behind it remained visible until some time after sunset, becoming more and more conspicuous as the daylight faded. The photograph in question, which shows the trail as an immense serpentine ribbon in the western sky, was taken at Tempe, Orange Free State, about an hour after the passage of the meteor. This remarkable meteor is discussed in Circular No. 1 of the Transvaal Observatory.

**The Temperature of Pine Needles in Winter.**—In the *American Journal of Botany* Mr. John H. Ehlers describes the results of measurements of the internal temperature of pine leaves in winter, obtained by means of ingenious thermo-electric apparatus. He found that these leaves, under winter conditions, maintain temperatures from 2 to 10 degrees (centigrade) higher than the surrounding air, owing to the absorption of radiant energy. The average of 650 readings taken in February between the hours of 8 A. M. and 3 P. M. was a little more than 3 degrees above the air temperature. This difference, says the author, is sufficient to be considered an important factor in photosynthesis.

**Lightning Conductor Containing Radium.**—Mention is made in a recent number of the German journal *Prometheus* of a lightning-conductor which, it is claimed, gives much more effective protection than the usual rod. The inventor took an ordinary lightning-rod and equipped it below the point with a disk that was overlaid by electrolysis with about 2 millogrammes of bromide of radium, so put on that it was weatherproof. The experiments made showed that the preparation of radium ionized the air, making it conductive, for a wide circuit around the point of the ligthning-rod. This led, naturally, to a decided fall of potential in the atmospheric electricity, and to equalization between the various strata of air lying in layers one over another. The charge of atmospheric electricity in these strata flowed toward the point through the air, which was still a good conductor even at a considerable distance from the point of the conducting-rod, and was carried from the point to the ground. In addition to the increase of radius of action of the lightning-rod, the ionizing of the air by a preparation of radium seems to cause the carrying off of stronger currents of atmospheric electricity.

**Electric Wire and Cable Terminology.**—No task is more difficult (and few are more important) than that of setting in order the vocabulary which has grown up spontaneously in connection with a rapidly developing art or science. The standardization of electro-technical terms has already made good progress, owing to the efforts of various electrical engineering societies and international commissions. The latest contribution to this task takes the form of a circular of the United States Bureau of Standards on electric wire and cable terminology. Misunderstandings between manufacturers and purchasers of wires and cables have frequently occurred in consequence of the divergent use of terms, and accordingly the standards committee of the American Institute of Electrical Engineers recently gathered information as to existing usage with a view to securing greater uniformity. The results were turned over to the Bureau of Standards, which continued the inquiry and prepared the definitions now published. The Bureau had special difficulty in securing agreement upon the words "strand" and "cable." According to the definitions adopted, a strand is one of the component parts of a stranded conductor, each part being either a single wire or a combination of wires. In the latter case, each wire of the combination is itself a strand of the composite strand, the principal idea in the word "strand" being that it is a component part of a larger unit. Some good pictures help to elucidate the principal terms defined.

## Automobile

**The Kaiser's Brother a Patentee.**—Heinrich Prinz von Preussen of Kiel, Germany, assignor of one half to a Berlin company, has secured patent No. 1,095,468 for an appliance for cleaning windshields on motor vehicles including wipers either on one or both sides of the glass which, by a quick stroke of the driver, may be moved over the glass to remove dust and water.

**A Garage in an Office Building.**—One of the latest improvements in office buildings, in the thickly populated eastern cities, is the installation of an automobile garage in the basement for tenants who prefer to come to the office in their motor cars. The first of these buildings is now in course of construction at the corner of Van Halst and Hunter's Point Avenues, Long Island City, N. Y., directly opposite the Long Island railroad station, and adjoining the Steinway Tunnel. The garage facilities are to be included in the rent, at a very small increase over the usual rate.

**Screwdriver and Hammer.**—No instrument in the whole line used by motorists is so frequently misused as the screwdriver. It seems second nature for a mechanic who happens to have one handy, and who needs something to drive a nail, or tack, or to straighten out a bulge, to use the screwdriver as a hammer. This is certainly not good for the handle of the screwdriver. Some bright genius has placed on the market a so-called "hammer-handle" screwdriver, which is exactly what its names indicates. It is both a screwdriver and a hammer, with the added advantage of affording more leverage to the fingers when it is used as a screwdriver.

**Automobile Racing at Night.**—A test was made at the Indiana State Fair Grounds recently of a system of illumination in order to demonstrate the practicability of automobile racing at night on a mile course. The test proved a complete success. Lights of the type used in contracting and railroad work for emergency operations at night were placed at intervals about the track. Each light was supplied with a cylinder of dissolved acetylene, and developed a light of from twelve to fifteen thousand candlepower. The test demonstrated that this form of illumination makes it as easy to follow the racing at night as in broad daylight.

**Assembling American Cars in England.**—Realizing that American automobile manufacturers have far outstripped British makers, particularly in the field of the low-priced car, British manufacturers are seriously considering assembling cars in Great Britain from imported American parts, and selling them as British cars. Last year one of the best-known designers of small cars in Great Britain placed a large contract for American gasoline motors and other parts in this country, to be used in a car of the Morris-Oxford type. The export statistics for March show no less than 3,500 of these motors were shipped to great Britain in that one month.

**Grooved Concrete Tracks for Trucks.**—Heavily loaded motor trucks have shown themselves so destructive of highways that in some of the States laws have been passed forbidding their operation beyond limited speeds and weights. A test is being carried out at present on a long private right of way between Pittsburgh, Kansas, and Fort Scott, Kansas. Trucks and cars desiring to use this road can do so upon paying a small toll. The road is fitted with cement or concrete tracks, 12 inches wide and concaved so that the wheels of an automobile will stay in them. It is a single track line, with switches at certain points, to allow machines to pass each other. If this road is successful it will be extended to Kansas City.

**An Auto Club With a "First Aid" Squadron.**—A new plan of general assistance has been inaugurated by the St. Louis Automobile Club, which deserves the widest publicity and imitation. This club sends each Sunday, during the summer months, five expert mechanics on motor cycles into the highways and by-ways surrounding the city, within a radius of fifteen miles. Wherever one of these members of the "flying first-aid squadron" finds a car that is stalled or broken down expert assistance is rendered. This service is free to all motorists, whether members of the club or not. It is proposed to extend the service to cover Saturday afternoons and evenings, when thousands of automobiles are seen on the roads around the city.

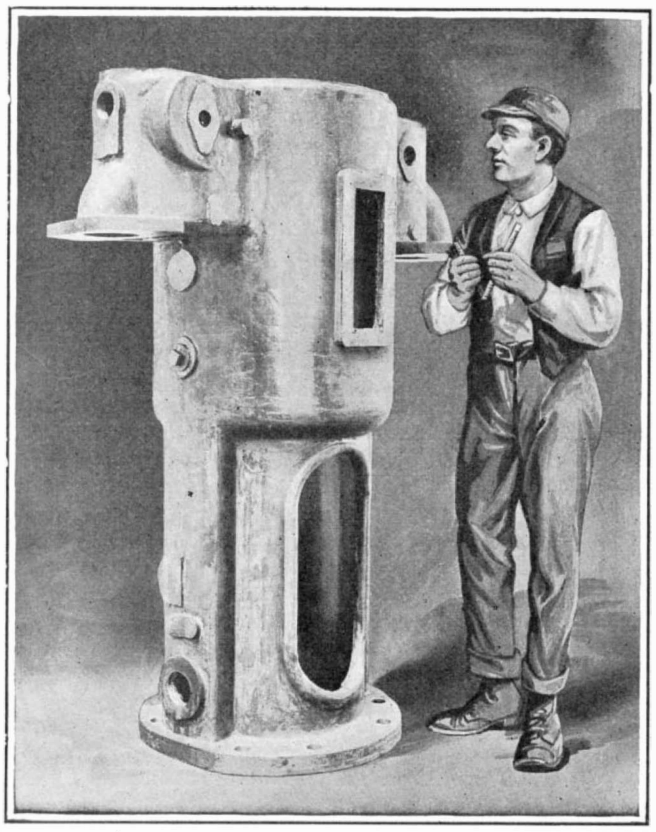
**Tubular Bulb for Car Lamps.**—A distinct improvement in the shape of bulbs for electric headlights has just been brought out by a Connecticut firm. The new bulbs are tubular in form, instead of being round, with the result that a much more effective light is produced. When a round bulb is inserted in the base of the headlight, rays from the filament have to pass through two and three thicknesses of the glass, on their way to and from the reflector. The tubular bulb, being but of slightly larger diameter than its base sends the reflected rays straight ahead without any further interference by the bulging bulb in the center. The tubular bulb has another advantage, which may on occasion prove highly important. It can be withdrawn through the rear of the reflector, making it possible to use front lenses which are screwed on tight, instead of being hinged to the lamp.

## Astronomy

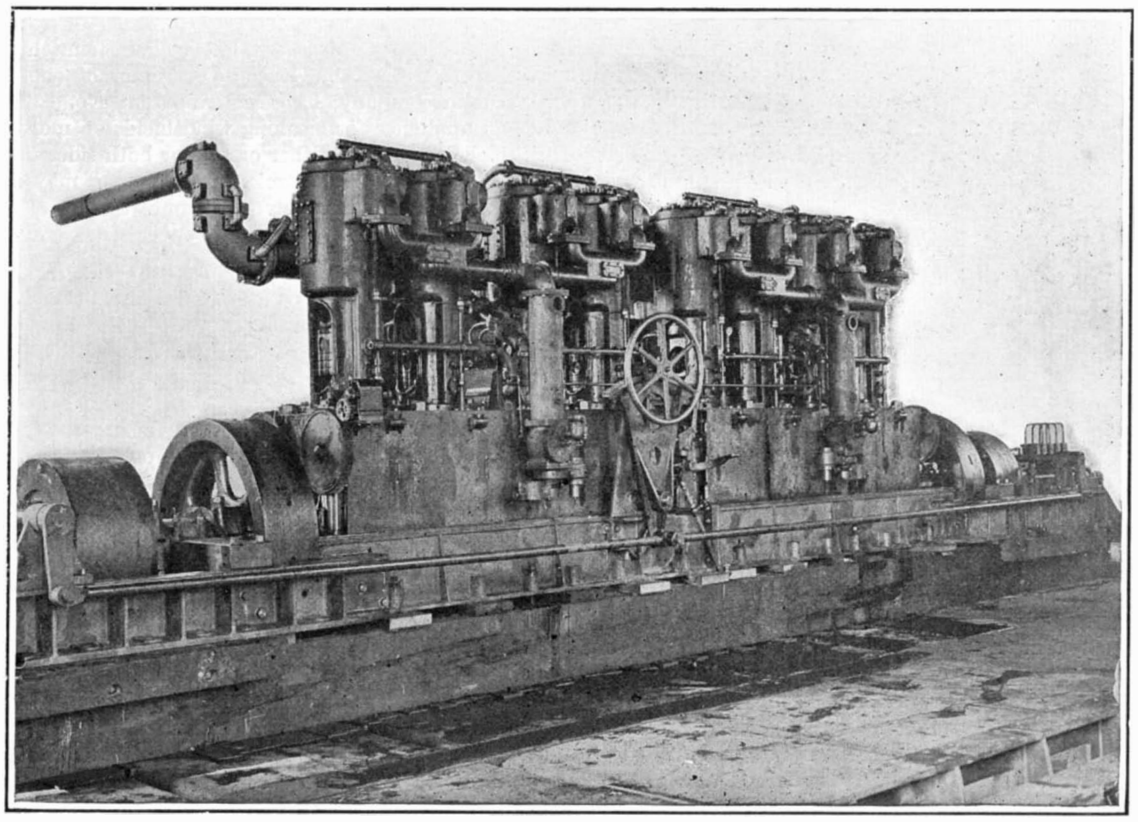
**Standard Tests for Small Telescopes.**—In a recent number of the *Comptes rendus* M. G. Bigourdan, after reviewing the present heterogeneous and often indefinite methods of testing small telescopes, proposes a testing device suitable for use as a universal standard. This consists of a collection of rectangular diagrams (shown in the article), each of which is a group of straight vertical and parallel lines, spaced at intervals of the same breadth as the lines. The thickness of lines and spaces increases progressively from group to group. A sheet of paper printed with these diagrams is set up at a distance of 10 meters from the telescope. At this distance the width of one line and the adjacent white space in the first group subtends an angle of 10 seconds, and in each of the other groups the width of a similar pair corresponds to a definite angle ranging up to 58 seconds. The values of these angles are shown by large figures. Thus in testing the telescope, the finest group in which the ruling is distinguishable indicates the extreme separating power of the instrument. Various other tests can be carried out; such as comparing the quality of different parts of the objective by the use of suitable diaphragms. While no novel principle is involved in this simple device, its general adoption would make the tests of small optical instruments uniform and definite.

**Atmospheric Conditions Favorable for Astronomical Observations.**—This important subject is more complicated than is generally supposed, according to Prof. W. W. Campbell, director of Lick Observatory, who goes into the question very thoroughly in the *Publications* of the Astronomical Society of the Pacific. The location of observatories on mountains and plateaus for the sake of securing clear skies and pure air is a comparatively modern development. Great efforts were made to induce James Lick to locate his observatory in the Sierra Nevada Mountains, at an altitude of not less than 10,000 feet, but other and probably wiser counsel persuaded him to select Mount Hamilton (4,200 feet). Some very extensive tests of sites have been made prior to locating observing stations; notably, on behalf of Harvard Observatory, by Bailey and Pickering on the west coast of South America, by Bailey in South Africa, and by Pickering in Mexico, Southern California, Arizona and the West Indies. The tropical island has had several recent advocates, a prominent one being Prof. W. H. Pickering, who has written in the most enthusiastic terms of the "seeing" conditions at Mandeville, Jamaica, at an altitude of 2,100 feet. The best "seeing" at Harvard Observatory ranges from 6.2 to 6.5 on the scale of 10 for perfection, while at Mandeville it is 8.8. The steadiness and definition of stellar images within 30 degrees of the horizon is as good at the latter station as that within 30 degrees of the zenith at the former. For solar observations one of the most favorable locations in the world appears to be the floor of the Kashmir valley, India, at 5,200 feet above sea-level. Several considerations besides actual "seeing" enter into the question of the best location for an observatory. Thus a favorable circumstance at Mount Hamilton is that nights are generally entirely clear or entirely cloudy.

**Belgian Astronomers and the War.**—The *Gazette astronomique*, published by the Society of Astronomy of Antwerp, was obliged to suspend publication after the events of October, 1914. Thanks to the financial aid of English friends, it has been provisionally re-established in England, and the first number under the new conditions (No. 9, 1914) was issued in April of this year. Its continuance will depend upon the amount of support it receives, and it will, in any case, appear at irregular intervals. A considerable part of the contents will be in English. An absorbingly interesting feature of the number just issued is the information given therein concerning the experiences of Belgian astronomers during and after the German invasion, including a graphic account of the occupation of the Royal Observatory, at Uccle, by German meteorologists. On August 20th the observatory—which in ordinary times is the headquarters of the national meteorological service as well as the national astronomical center—was made a "field weather station" of the German army, similar to those established by the Germans at Liége and Namur, and later at points on the Belgian coast. Four German meteorologists, guarded by a company of soldiers, moved in, bag and baggage, and at once began making regular observations, not only of surface conditions, but also of the upper air-currents, with the aid of pilot balloons, including electrically lighted balloons for the night observations. The results were telegraphed to the Deutsche Seewarte at Hamburg. About the middle of November the observatory was made the "field weather center," or headquarters of the whole system of field weather stations maintained by the German forces. Meanwhile several Belgian astronomers, who had remained at the observatory, were allowed to continue their astronomical work, including the service, and this arrangement is still in force. The regular meteorological work of the observatory, on the other hand, which included the publication of the valuable daily weather maps, is discontinued.



One of the big cylinders—bore, 16 inches; stroke, 20 inches.



An eight-cylinder 600 horse-power gasoline engine; weight, 120,000 pounds.

## Largest Commercial Gasoline Engine Ever Built

IN view of the recent developments of the gasoline engine in eight-cylinder units, unusual interest attaches to an engine which has just been completed on the Pacific coast. Although designed for marine work, it shows to a remarkable degree the influence of automobile practice in its general appearance. With a total weight of approximately 120,000 pounds, it is unquestionably the largest commercial gasoline engine ever constructed, and its operation is being watched with considerable interest by automobile as well as marine engineers. In these days of Diesel and semi-Diesel engines it is noteworthy that an engine of the electric ignition type should be built in so large a unit, for although higher-powered gasoline engines for racing purposes are not uncommon, heavy, slow-speed engines for commercial service have rarely been built in sizes over 250 horse-power. This 600 horse-power unit is the climax of a gradual development of the heavy gasoline engine which has taken place on the Pacific coast.

The engine measures 46 feet over the thrust bearings and, as previously stated, weighs about 60 tons. As shown in the photograph, the eight cylinders are cast separately and are mounted in line on a plate which is supported from the bed by vertical columns. The cylinders are exceptionally long, measuring nearly six feet. The lower half of each is cut away on two sides to form cross-head guides. It has a bore of 16 inches and a 20-inch stroke. Each cylinder casting weighs 1,700 pounds.

The valves are disposed on either side of the cylinder forming the familiar "T" head and are operated from separate cam shafts under the cylinder plate. Fuel is supplied to the engine through two carbureters in conjunction with two heated intake manifolds, the latter being so constructed that they are heated by the exhaust of the engine. It is claimed that this prevents condensation of the mixture between the carbureter and cylinder and gives a very flexible engine. When running light the speed may be reduced to 38 or 40 revolutions per minute. The normal speed of the engine is 225 revolutions per minute.

This machine has been installed in a double-ended ferryboat utilized for the transportation of trains across an arm of San Francisco Bay. This vessel is 236 feet long and 58 feet wide, carrying three tracks on the main deck. The engine is set in the center of the vessel and is connected through clutches to propellers on either end.

Notwithstanding the high cost of fuel for operating an engine of this size, a considerable saving over steam has been effected, by reason of the intermittent service. The trips made are not long, and between runs the engine is of course stopped, thus eliminating all fuel expense while the boat is not in actual use. Starting is accomplished by means of compressed air.

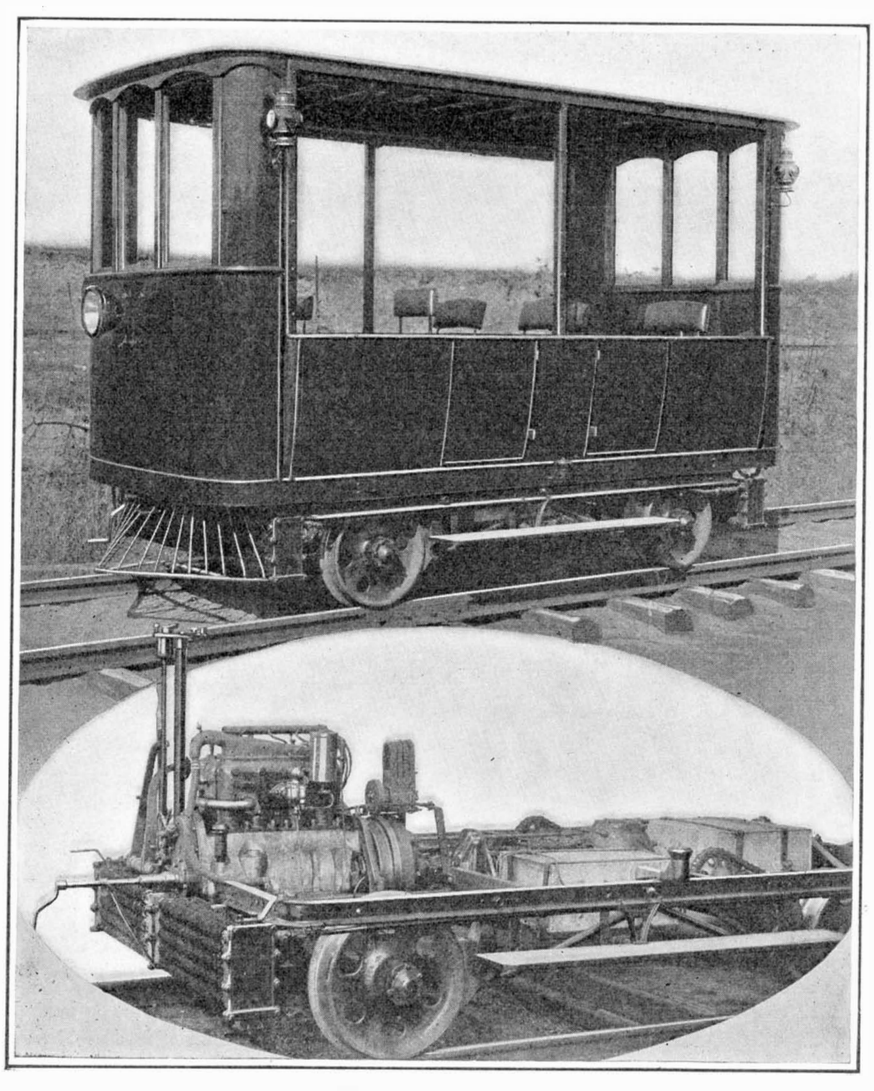
## Inspecting Steam Railroads With a Gasoline Car

THE automobile has very nearly supplanted the horse-drawn vehicle, the jitney-bus is becoming a formidable rival of the street car, and now even the steam railroad is being invaded by the motor vehicle. The accompanying photographs illustrate a new motor-driven car adapted for railroad inspection.

The handling of the car is exactly like that of an automobile. It is capable of all speeds from four miles to fifty miles an hour. In general construction, appearance and finish it is strictly a railway car and not an automobile, although in some respects the general design resembles the same. The car is mounted on steel wheels with turned treads and easy spring suspension, which overcomes the fatigue generally resulting from long trips in other cars used for this purpose. There are eight seats, each independent and swiveled so that they can be swung in any direction, facilitating conversation or inspection of the track.

A 30 horse-power motor is used, which drives through a clutch of single plate design and a three-speed transmission to a jack shaft by means of bevel gears. On the jack shaft the drive is by chain to each of the rear wheels. No differential is required in work of this kind, and by means of a double bevel gear arrangement, all speeds can be obtained in either direction, and the car operated equally well either way. The car weighs 4,000 pounds and is 12 feet 8 inches long and 5 feet 8 inches wide when built for standard gage track.

The utility and economy of this type of car can be appreciated when it is considered that such trips are usually made by special train, or at least in a special car attached to a regular train. Under such circumstances the officials are not free to stop at any or all points where they might desire and so are kept from getting into close touch with the different problems on their roads. The No. 35 Motorcar permits them to run between trains and to stop at bridges for inspection or to consult with the section gang, or to talk with the farmer about some stock which he has lost through a broken-down fence. The tendency of the present day on the part of the railroad officials is to get as closely as possible into personal touch with all those who have to do with the road in any way, either as passengers or employees, or as property owners along the way.



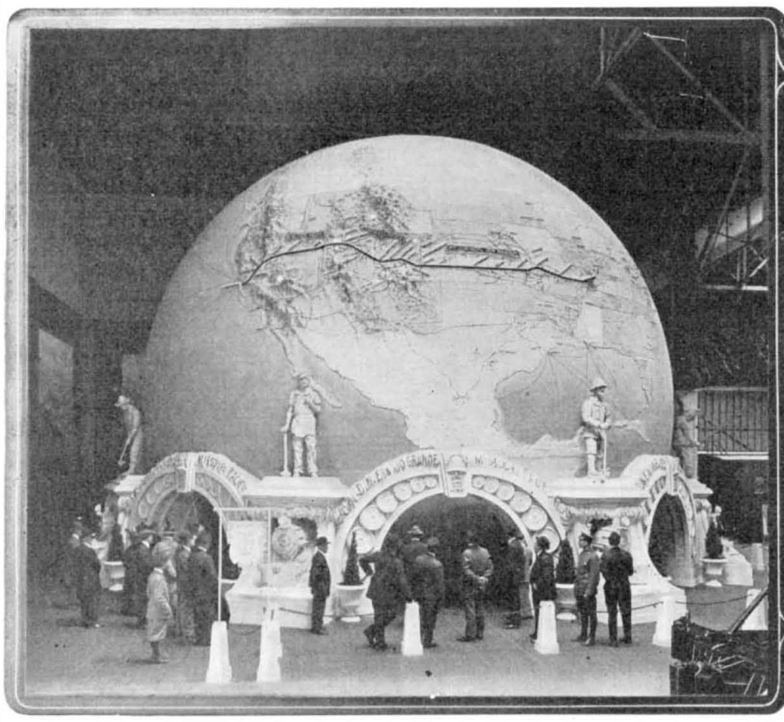
Gasoline-driven railroad inspection car.

## Italy and the Copyright Proclamation

FOLLOWING the provision of the Act of Congress of March 4th, 1909, respecting copyrights and satisfactory official assurance having been given that in Italy the law permits to citizens of the United States similar rights to those accorded in Section 1 of the Act of March 4th, 1909, President Wilson by proclamation dated May 1st, 1915, has declared that the subjects of Italy are entitled to all the benefits of Section 1 (e) of the said Act, including "copyright controlling the parts of instruments serving to reproduce mechanically the musical work," in the case of all musical compositions by Italian composers which have been published since May 1st, 1915, and have been duly registered for copyright in the United States.

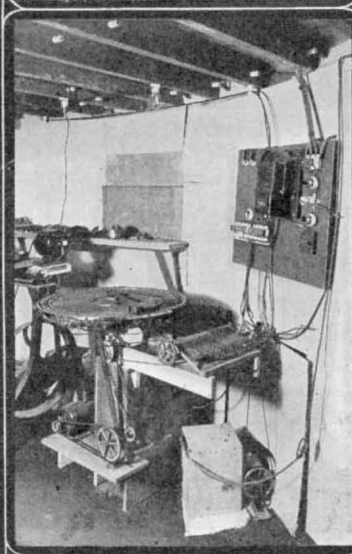
## Sixtieth Exhibition of the Royal Photographic Society

THE sixtieth annual exhibition of the Royal Photographic Society of Great Britain will be held in August and September, next. This is the most representative exhibition in the world, and for a number of years America has taken a most gratifying part in it. Last year the work of American scientific men was conspicuously noticeable, and it is hoped the representation this year can be made fully as excellent. This work should consist of prints showing the use of photography in scientific work, and its application to such branches as spectroscopy, astronomy, radiography, biology and the like. Mr. C. E. K. Mees of Rochester, N. Y., who superintended the collection and forwarding of the American exhibit last year, has again undertaken the work, and asks that contributions be sent to him as early as possible. The photographs should be mounted, but not framed, and should be sent in not later than July 1st.

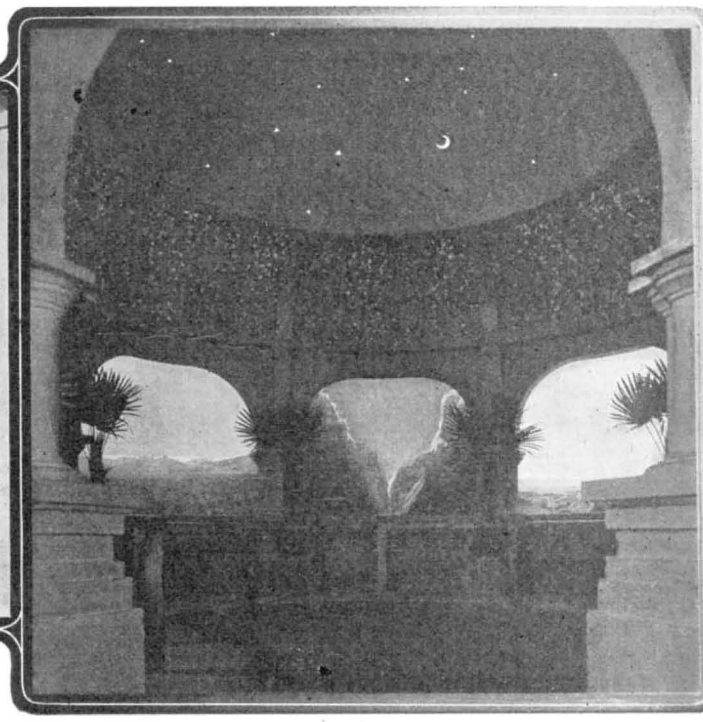


"The Globe," at the Pan-Pacific Exposition.

Exterior view, showing the trains, composed of electric lights, that leave San Francisco for St. Louis every 20 minutes, and illuminate the names of the principal cities *en route*. Each of the arches contains an illuminated, realistic model of an interesting scene along the line.



**Electrical devices under the globe that control the movements of the train, the twinkling of the stars, running water and other startling effects.**



**Interior of "The Globe," showing three illuminated models of scenes along the route covered by the train of lights.**

Note the sky effects in the dome, with realistic moon and stars. These are lighted and the stars are made to twinkle at the will of a concealed operator.

## The Largest Spherical Relief Map in the World

TO the thousands who visit the Palace of Transportation at the Panama-Pacific International Exposition a giant globe in the northwest corner of the building is an unfailing source of attraction.

The globe is the exhibit of the Denver & Rio Grande and affiliated railroads.* It is 52 feet in diameter and 44 feet in height. The base, which is cut off, rests upon an imposing pedestal with arched entrances admitting sightseers to the interior of the sphere.

The exterior of the great globe is embellished with a colored topographical map of North America, on which the various routes of the railway system are shown and which presents in detail the various topographical features of the continent.

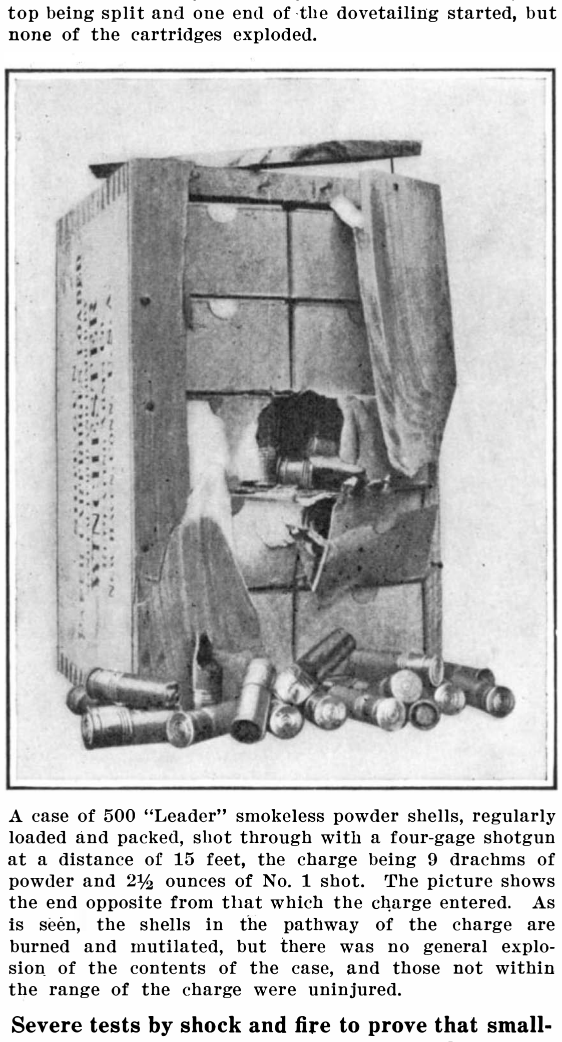
Apart from its size, since perhaps it is the largest spherical relief map in the world, the feature of the exhibit which first attracts the eye is the unique electrical effect which indicates the progress of trains over the routes. The representation is effective. A progressive stream of light indicates that a train is passing through the principal cities and towns along the line, and as each of these is reached the name of the city is flashed electrically, attracting the attention of the spectator to that particular point. Much work was involved in the creation of the electrical effects. For the train effect alone it was necessary to run 1,500 wires from the "track" on which the train is represented as running, to a circular drum in the interior. On the top of the drum is an arm which constantly turns in a circle, making and breaking the contact which produces the train effect. On each complete revolution of the arm a train makes a complete trip from San Francisco to St. Louis. In addition to the illumination of the names of towns, the name of each railroad is flashed in red above its portion of the routes while the train is traversing it and disappears when the next road is reached. The connections are arranged to show a departure from San Francisco every twenty-two minutes, and consequently there are several trains on the line at the same time between the Pacific coast and the Mississippi River.

The interior of the globe is as effective as the exterior. The principal feature of the interior and of an annex to the rear is found in a series of illuminated dioramas with the foreground built to resemble nature. The dioramas, of which there are twenty-four, portray the principal places of interest along the route. A winding causeway permits the visitor to behold upon the right and left the different dioramic scenes in the order in which they are viewed in a journey over the railroad. The attractive features of the cities and the natural show places are depicted; cañons, waterfalls, gorges, far-away mountain vistas are reproduced in scenes partly painted and partly modeled, and under the colored lights, give the effect that one receives when gazing from a mountain top at some distant perspective when a section of the world seems laid out in miniature. A statistician estimates that three million billion feet of scenery is reproduced. Agricultural scenes also are presented and the effects of sunrise and sunsets, storms and night scenes are realistically produced by electricity.

The interior of the dome, which is remarkable for the fact that despite its size it is a section of a perfect sphere, gives an effective illusion representing the heavens at night, with twinkling stars and forms resembling the constellations, which add greatly to the realism of the scene. The stars are operated from an electrical room below by means of a revolving cylinder which by making and breaking the contacts produces the twinkling effects. Although the darkened vault of the interior of the sphere in which the constellations are set is but 45 feet in height, it is difficult indeed for the visitor to approximate the actual distance of the faintly flashing lights and brightly twinkling stars.

* Western Pacific, Denver & Rio Grande, Missouri Pacific and Iron Mountain.

A case of 1,000 0.30 U. S. Army cartridges, smokeless powder, regularly loaded and packed, dropped 25 feet onto an iron floor covered with oak planking, landing on end and corner. Photographed as it lay after the fall. This case was badly broken by the force of the fall, the top being split and one end of the dovetailing started, but none of the cartridges exploded.



A case of 500 "Leader" smokeless powder shells, regularly loaded and packed, shot through with a four-gage shotgun at a distance of 15 feet, the charge being 9 drachms of powder and 2½ ounces of No. 1 shot. The picture shows the end opposite from that which the charge entered. As is seen, the shells in the pathway of the charge are burned and mutilated, but there was no general explosion of the contents of the case, and those not within the range of the charge were uninjured.

**Severe tests by shock and fire to prove that small-arms ammunition will not explode.**

## Safe Transportation of Small-arms Ammunition

WE have shown in a previous issue that a single submarine torpedo because of its enormous charge of explosive was quite sufficient to sink the "Lusitania" in the short period of time which elapsed between the blow of the torpedo and the disappearance of the ship. The German government has suggested that the rapid disappearance of the ship was due, in part at least, to the explosion of the cargo of ammunition which it carried. To a military man, or indeed to anyone with a fair knowledge of explosives, the suggestion is ridiculous; for the ammunition in the hold of the ship consisted of unloaded shells, and of small-arms ammunition packed in cases which cannot be exploded by any known means.

Some years ago the Winchester Repeating Arms Company, in order to prove that small-arms ammunition could be transported with perfect safety, undertook a series of severe tests to show that such ammunition packed in the ordinary cases was incapable of being exploded either by shock or flame; and we publish herewith a series of photographs of the ammunition as it appeared after passing through the test.

Subsequently, Gen. George Uhler, Supervising Inspector General of the Steamboat Inspection Service, Department of Commerce and Labor, authorized Col. B. W. Dunn, Chief Inspector, to carry out at the factory of the Winchester Repeating Arms Company an additional series of tests, more severe than those made by the company itself, with a view to determining the safety or otherwise of the transportation by rail or steamer of small-arms ammunition. The tests were duly made, and in his report to the department Col. Dunn said: "In connection with similar tests made previously, it is believed that these results justify the conclusion that small-arms ammunition, while in transit either by rail or steamship, is not accompanied by the explosive and fire risk that would accompany a shipment of the same amount of explosive material in the kegs, boxes and other shipping containers used for such material. The freedom of small-arms ammunition from these risks is due to the necessary sub-division of this explosive material into the very small, well-protected units furnished by the individual cartridges.

"*It is the opinion of the writer that you would be justified in permitting the shipments of small-arms ammunition on passenger-carrying steamers, and that it would not even be necessary on these steamers to require ammunition of this kind to be loaded in the magazines provided for gunpowder and other explosives.*" (The italics are ours.)

Smokeless powder of the kind carried by the "Lusitania" is slow-burning. If a stick of it be held at one end and the other end be lighted with a match, the powder will burn slowly and without any explosive effect. Smokeless power of the nitrocellulose variety is simply colloided guncotton, and the colloiding has the effect of making it slow-burning. The wave of explosion of guncotton, nitroglycerine, or any other of the high explosives, is instantaneous throughout the whole mass; that is to say, the whole of the energy of the explosive is developed instantaneously, and hence its enormous disrupting effect. It is impossible, however, to detonate any of the smokeless powders. The rate of combustion

of such powders can be accelerated by burning them in a closed chamber and permitting the pressure of the gases of combustion to accumulate, which is exactly what occurs in the modern smokeless-powder rifle, in which the rate of burning is so determined that the last grain of the powder will be consumed and converted into gas at about the time that the projectile leaves the muzzle of the gun.

The nearest approach to an explosion of a large quantity of smokeless powder aboard ship would be the ignition of a magazine full of such powder. The increase of pressure, due to the confined gases, would increase the rapidity of the burning, and a degree of pressure would soon be reached at which the magazine would be torn open and the ship more or less wrecked.

In the case of small-arms ammunition, however, where the powder is separated into the small quantity contained in each cartridge, there is no possibility of such a burning in mass. This was proved in the experiments carried on by the Winchester Arms Company and subsequently repeated by Col. Dunn in tests of even greater severity.

In the company's test the cases of cartridges containing smokeless powder were dropped 25 feet onto an iron floor; and in the case of the test made by Col. Dunn for the Steamboat Inspection Service, the boxes were subjected to a fall of 50 feet. The particulars of the company's test are given beneath the respective photographs. In the shooting test made by Col. Dunn a case of 12-gage Repeater loaded paper shot shells, loaded with 24 grains of Infallible smokeless powder, were packed in a case, the cartridges horizontal and perpendicular to the path of the bullets. Three shots were fired. After the first and second shots, no smoke issued from the box, and apparently there was no ignition. The third shot was followed by a slight amount of smoke issuing from the bullet hole, and in a short time smoke issued from the top of the box. Only two of the cartridges were ignited.

In the Government burning test, Repeater smokeless powder loaded paper shells and Nublack black powder loaded paper shells were placed on an iron grating and a pile of wood saturated with kerosene was placed beneath the grating and set afire. In twelve minutes' time there was a popping of the cartridges, which exploded individually with a firecracker effect. Col. Dunn's report states, "There was nothing approaching a powder explosion. . . . The test indicates that larger quantities of the same kind of ammunition might be burned without causing any destructive explosion." As a result of Col. Dunn's report, the Supervising Inspector General issued the following circular letter to the United States supervising and local inspectors, the chief officers of customs and others concerned:

"The tests of the handling of small-arms ammunition and the rough usage to which it may be subjected without risk of danger from fire or explosion, having been witnessed by representatives of this department, you are advised that the results of these tests justify, beyond doubt, the conclusion that small-arms ammunition may be transported without restriction on steamers carrying passengers, and that it need not be confined to the magazine of the vessel as heretofore required."

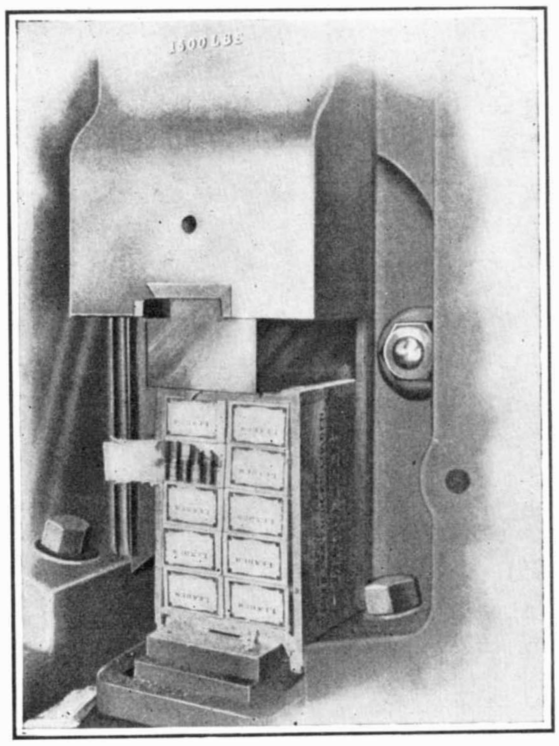
## Strategic Moves of the War

**By Our Military Expert**

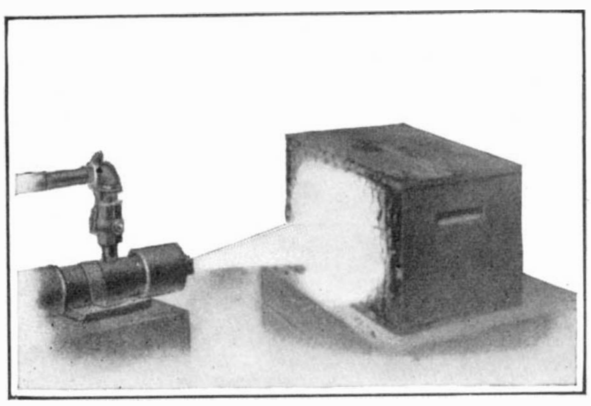
ITALY'S entrance into the war overshadows all other recent events and speculation is plentiful as to the effect this will have, not only on the developments of the immediate future, but also on the final outcome of the war. Another arc has been added to the ring of fire gradually closing about the Germans, and if the Balkan States should now see fit to follow the example of Italy, the circle would be nearly complete. If the Germans had only to consider the measures they must take to meet this new horde, so suddenly thrown into the fray against them, they would have problem enough to occupy them indefinitely; but they must also make arrangements for the immediate replacement of the supplies of all kinds they have been receiving from and through Italy. This door is now closed to them, and with a formidable enemy to face, their supply of war materials must be appreciably increased at the same time that one of their sources of supply is cut off. A heart stouter than that of a German might quail before such an enormous task.

The Germans probably were not surprised by this decision of Italy, and no doubt they have made such preparations as they could, during the closing period of the negotiations at Rome, to meet the advance of the Italian army should war be Italy's final decision. To what extent they have been able to do this the events of the next few weeks will show. German system and organization, not only in military but in civil affairs as well, are admittedly perfect and capable of accomplishing marvels in great emergencies; but there must be a limit beyond which they cannot go. Is the advent of Italy to be the additional burden that will start the Teuton giant to tottering and finally bring about his fall?

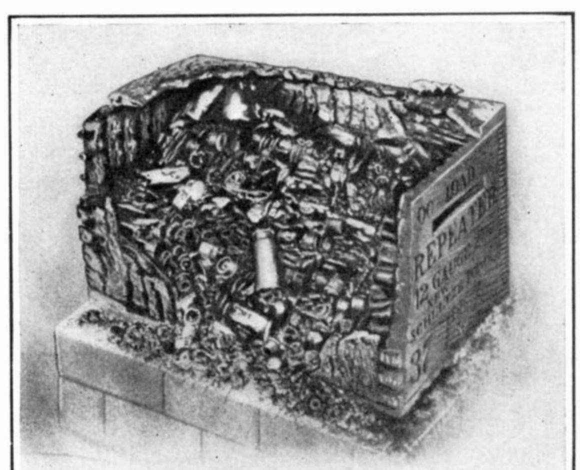
There had not been a time since the opening weeks of the war when the Teutons' star stood as high as just before Italy's declaration of war on Austria. While holding the Allies with fair success on the western front in France and Belgium, with some probability of the same conditions of stalemate being developed along the Dardanelles, they were carrying everything before them in their spectacular and wonderfully successful drive



A case of 500 "Leader" smokeless powder shells, regularly loaded and packed, struck a blow by a 1,500-pound drop hammer allowed to fall two feet. The entire column of shells was crowded together about 2⅜ inches, shortening each shell nearly half an inch. As is seen, the anvil was forced up through one end of the case, the top and bottom split off, and the shells compressed, but none of them exploded. This is the severest of severe tests of the effect of general shock to a case of shells or ammunition.



A case of 500 "Repeater" smokeless powder shells, regularly loaded and packed, subjected to fire and heat from a gas blowpipe. As is shown in the picture, the side of the case is burned through and badly charred. The expert conducting the test stood close enough to the burning case to rest his hand upon it.



This picture shows the case after the flame was turned off. When the blowpipe was turned off, the fire in the case went out after a little, illustrating that ammunition will not continue to burn by itself. As is shown by the appearance of the case and contents, there was no general explosion of the shells, the case remaining intact, except that part of it destroyed by the flame.

**Severe tests by shock and fire to prove that small-arms ammunition will not explode.**

against the Russians in Galicia. This probably will rank as the greatest battle of the war to date, as measured by the number of men engaged and the results obtained. We may or may not believe the reports that have reached us of hundreds of thousands of Russian prisoners taken, and we may be certain that the German losses have been tremendous. In war these things are to be accepted as incidents, more or less trivial. To quote Napoleon, "An omelette cannot be made without breaking the eggs." The German omelettes may have been expensive; but that fact can be forgotten if they are eaten on a victorious battlefield. In war, victories are what count. Grant did not fight his way from Washington to Richmond without losing many men and fighting many battles; but each battle was a victory and left him a step nearer the final overthrow of the Confederacy. To date, the tide of battle in Europe has ebbed and flowed, and the period of the war apparently has not yet come when one side or the other can assume a not-to-be-resisted offensive that accumulates one victory after another and brings about an end of the war.

If Germany and Austria are to profit permanently by the temporary advantage gained over the Russians they must follow up their success by further offensive moves in such strength that victories will succeed each other. Even without Italy to be reckoned with this would have been a stupendous task, but it becomes well-nigh impossible in face of the necessity of putting a powerful and well-equipped army on the Italian frontier. Neither Russians nor Teutons have been able to advance far into the territory of the other. When they cross the hostile frontier they find the railroads less to their liking; supplies, ammunition and reinforcements cannot be brought to the front and wounded cannot be sent to the rear with as much speed as when on friendly soil. Lines of communication are longer and in greater danger, and undefended flanks of the army are left hanging in the air, inviting attack. Germany, some months ago, was able to advance victoriously on Warsaw, until inadequate railroads in Poland and an over-extended fighting line gave Russia, with increased railroad facilities, the advantage she needed to drive the invader back. Russia recently fought her way to the crest of the Carpathian Mountains and paused to gather her strength for a further advance; but this was a slow process, and before it was completed the Germans and Austrians, taking advantage of the admirable system of railroads within their own borders, were able to concentrate a vast driving force at the exposed portion of the Russian line, and proceeded to march through Galicia, rolling up a part of the Russian army and compelling the abandonment of the Carpathian position.

Now the Germans, in their turn, are confronted by the same danger. Again success may be but the prelude to defeat. The force of the German blow appears to be about spent. Before the blow can be repeated new energy must be accumulated through the acquisition of reinforcements and large quantities of supplies and ammunition. Russia should be the first to recover. Any day we may hear of the advance of new Russian forces from the north against what appears to be the exposed portion of the German line. In no previous campaign have the Teutons had so large a stake to play for, and success in other theaters probably will be regarded by them as of minor importance so long as there is doubt of their ability to hold the territory they have wrested from Russia.

The east is likely to continue to be the main theater of the war for some time to come. Viewed very broadly, there have been two main phases of the war to date. It seems to be well established that the plan of the Germans at the outset was to crush France before the more slowly moving Russia could mobilize her masses. They failed to do this. In the meantime the menace of the advancing Russians increased until, because of this and other important conditions, the east became the main field of operations. If the Germans are to win, their superior leadership is the main factor they possess with which to more than offset the superior numbers and other advantages of the Allies. So important did they deem this in the opening of the war, that they did not hesitate to go to the extreme of violating the neutrality of Belgium in order to get the room necessary for the employment of their armies in a way that would make that leadership effective. When the western line became continuous, from the sea to Switzerland, and warfare there was reduced to siege operations, the opportunity for full exercise of superior leadership disappeared. In the east conditions are different. The distances are so great as to furnish ample room for strategic combinations of vast numbers of men, and their employment in accordance with the principles evolved by the German General Staff. The Germans claim to be superior in this class of leadership and point to the victories of Von Moltke, their great leader in two wars, to substantiate their claims.

The advent of Italy may compel the Germans so to weaken their offensive in the east that Russia may not only recover the lost ground, but also continue her victorious advance through the Carpathians and on to Vienna; and the history of the war may record that Italy entered the contest at a critical moment and turned the tide for the Allies. And it may also record that the German allies played a desperate game, allowed Italy to overrun a portion of Austria opposed only by weak forces, further weakened their armies opposed to the French and English in the west, and continued their violent offensive campaign against

Russia with every available man and gun.

Another three months should show whether the entrance of Italy is to have a decisive effect on the final outcome, or whether the German allies will be able to put forth the almost superhuman effort necessary to restore the balance to somewhere near what it was before Italy declared war.

Since the above was written, the great Teutonic drive through Galicia has culminated in the recapture, on June 3rd, of the great Galician fortress of Przemysl. So far as the evidence can be gathered, the victory was due to the preponderance of guns and ammunition possessed by the victorious Austro-German forces. The Petrograd official report of the capture of Przemysl definitely states that the Russian forces suffered from lack of ammunition; and, in the absence of any contradictory evidence, this must be accepted as the truth. How far into Galicia the Teutonic army can continue its advance, unchecked, is a matter of pure conjecture. There is no evidence that Russia lacks in men, and if she can rush the needed supplies of material to the front, she may succeed in stemming the tide of invasion somewhere between Przemysl and Lemberg. In any case this great victory is bound to have a profound effect upon the whole situation; and if the Germans should be content to dig themselves in and hold the Russian lines on the present front, it is conceivable that they may be able to detach considerable forces to meet the crisis which has been developed by the entrance of Italy into the war.

### The Germ of Typhus Fever

TYPHUS fever has since the Peloponnesian war at least, been traveling companion to Mars; and its various names—famine, siege, camp, putrid fever—have well indicated the relationship. An adequate history of this infection would be the history of Europe since Charles V, to go no farther back. With its congeners—smallpox, cholera, plague, typhoid—typhus has modified the course of most wars, has indeed abruptly ended some wars. The widespread Napoleonic campaigns served to disseminate typhus throughout Europe; and now, a century after, the like pandemic condition is liable to obtain. And only by the proved ability and vigilance of our coast quarantine authorities are we assured of being spared "visitations" of this pestilence.

This typhus is a filth disease, transmitted by the louse's bite, and only that way. Brill's disease, of which more presently, is a mild form of typhus; and our American tabardillo, which our American physician Ricketts was martyred in studying, is "the thing itself."

The typhus mortality is especially high among military surgeons—it has been 60 per cent; and indeed, up to May 1st last above two hundred doctors and nurses have died in Serbia fighting this so indifferent ally to any and every foe—this slayer of non-combatant and soldiery alike, far more destructive than any ordnance. The only effective means thus far has been to eradicate the louse; which, in the circumstances now obtaining in many parts of Europe, is a procedure as available as was sweeping the Augean stables. So that now, more than ever before in history, is the need of some such prophylactic against typhus as has been so successful against smallpox and typhoid, as has been successful in considerable degree against cholera and the plague. And, indeed, the blessed boon would seem to be forthcoming at this, the psychological moment.

In the pathological laboratory of Mount Sinai Hospital, in New York city, Dr. Harry Plotz, a physician not yet twenty-five years old, isolated from the blood of Brill's disease sufferers a rod-shaped (bacillary vegetable) parasite which Dr. William H. Welch has named the *Bacillus typhii exanthematus*. This germ when first isolated is anaerobic (unable to exist in the presence of oxygen); but after a time it can be grown aerobolically (in the presence of air). It is pleomorphic (occurring in various distinct forms), 0.9 to 1.93 microns long and in breadth one fifth to three fifths its length. It is not acid-fast, it has no capsule, and polar bodies can be demonstrated in it. At the time of this discovery the Balkan war was sending over plenty of "straight typhus material"; and Dr. O'Connell, the physician at the Port of New York, allowed Dr. Plotz to take blood from such patients; and these specimens yielded the bacillus got from the Brill's disease sufferers.

Complement fixation tests were then made by Dr. Plotz and his colleague, Dr. Peter K. Olitzky. They used the serum of eight cases of typhus fever; and antigens were made up from organisms obtained both from cases of Brill's disease and straight typhus. The antigen made from the Brill's disease bacillus binds the complement in the same manner as the antigen made from the bacillus isolated from the typhus cases. And complement fixation tests were made in thirty-six control cases with absolutely negative results. Inoculations in guinea pigs of a pure culture of the bacillus gave the disease to those animals. And serum from a convalescing typhus patient was proved to have bactericidal properties against the organism obtained from Brill's disease. Thus, the latter is really an endemic form of typhus, the real, the virulent form being manifest in that epidemic now ravaging Serbia.

These findings Dr. Plotz reported in the *Journal of the American Medical Association* of May 16th, 1914, and on the evening of April 14th last, before the Pathological Society of New York and to the applause and most hearty congratulations of many eminent physicians and scientists, Dr. Plotz announced not only the discovery of the germ of typhus, but also that this discovery has resulted in the perfecting of a preventive serum. It is, of course, too early to be certain of its efficacy; however, many physicians going to Serbia to fight typhus have had themselves inoculated with it, thus evincing their faith in it.

### The Current Supplement

WHAT new discoveries are possible in the actual state of science, which would be most desirable, are questions that are considered in the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT, No. 2058, for June 12th, 1915, and the opinions of a large number of noted scientists are given. The substitution of electric for steam power on railroads is a subject that is being discussed with increasing frequency, and from the number of new electrifications that are being made there appears no doubt but that this matter is sure to be of more vital importance, and in the not distant future, than possibly over-conservative railroad men have acknowledged. In this issue is an illustrated description of the electrical equipment of a difficult section of the Norfolk & Western road that has just been put into operation, and is successfully handling heavy tonnage on mountain grades and expediting traffic generally. Another finely illustrated article of general interest is the story of the night illumination of the Pan-Pacific Exposition, which is a triumph of the electrical illuminating engineer, and a marvellous demonstration of modern lighting methods. Electrometallurgy gives an interesting summary of electrolytic methods of extracting various metals and of purifying them. The gyroscope has attracted so much attention of late, both on account of its applications to the aeroplane, and its use in directing the deadly under-water torpedo, that many are desirous of learning how it works. Most descriptions of the action of the gyroscope are so technical that they are quite difficult to understand, especially as the action is a subtle one. Prof. Newkirk of the University of Minnesota gives us the best and simplest explanation that has been published, and illustrates it by excellent sketches. Tides in the Earth's Crust is a valuable contribution for the geologist that will be appreciated by students of science. There is an interesting article on the Time System of the United States, as well as a variety of other useful and readable matter.

### A Submarine Sunk by a Zeppelin

**By C. Dienstbach**

THE first pitched battle has recently been fought between ships of the sea and of the air, resulting in the annihilation of a British submarine by a Zeppelin bomb. This fact seems so striking that an attempt to analyze the lesson taught by this experience, isolated as it is, may be worth making. It is well known that British submarines are specially armed with anti-aircraft guns, which disappear in a recess when the vessel dives, but which are of fairly heavy caliber (among their class) and capable of firing at a steep angle.

While the English underwater craft generally have not yet shown much activity very far from repair shops, their employment as anti-aircraft patrols would seem a very fitting task. Their speed is of course hopelessly inferior to a Zeppelin's, but so is that of the fastest cruiser relatively. But, as in the famous story of the race between the hare and the hedgehog, the submarines might suddenly emerge into conspicuousness just at the goal of the race. The Zeppelin must indeed have been caught exactly like the hare, for voluntarily it would hardly have accepted a fight at such tremendous odds. A submarine flotilla's numerous high angle guns are not so very much smaller than those of a battleship, yet the target offered by the single submarine is so hopelessly tiny that the Zeppelin's escape after sinking one of her foes with a bomb appears nothing short of marvelous, if we recall the difficulty of dropping bombs with precision and the accuracy of high angle fire so far experienced. Mere luck must have played the principal part in the encounter. There would remain just this explanation, that the Zeppelin's speed (with the wind) took her extremely quickly into the conical space directly overhead that is not yet swept efficiently by high angle fire, and that the several bombs mentioned in the report were dropped in such quick succession as to offset any miscalculation of speed and height by their "scattering." Nevertheless, if a tiny submarine was squarely hit by a bomb, the same might much more likely happen to a colossal dreadnought (and that bomb may weigh a ton), which is hardly better defended against the air.

## Correspondence

*[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]*

### Compulsory Licenses and Working Clause

To the Editor of the SCIENTIFIC AMERICAN:

Samuel S. Dale, in his letter published in your issue of April 24th, does little to impair the argument of Commissioner of Patents Ewing against compulsory license and compulsory working of patents.

Mr. Dale adopts a curious course of reasoning:

"The British working clause of 1907," he declares, "caused an immediate development of manufacturing which had previously been conducted in foreign countries." "But this is not the model," Mr. Dale hastens to assure us, "which we ought to follow." "Advocates of a working clause," he declares, "are not urging the adoption of the provisions of the British patent system." What then are they advocating? Mr. Dale replies: "They are advocating the adoption of an effective working clause in the United States law." But what the terms of this shall be, in what way it shall improve upon the British law and specifically just what it is, Mr. Dale does not state.

There is always a sure, quick and infallible test to apply to enthusiasts with legislative proposals; and that is to compel them to phrase in specific language just the law they want. If their ideas have merit, they readily stand the test. If they lack merit, the process of trying to satisfy the test is always educative to the community and sometimes especially educative to the enthusiast. Perhaps, if Mr. Dale will acquaint himself with the literature which has already accumulated upon this subject and read all the hearings which have been held during the past few years by the House Patent Committee, he would see the answer not only to all the questions which he now raises, but to many other questions which much more industrious students of the problem have raised.

Mr. Dale's quotation from the recent speech of the president of the British Board of Trade is strangely misdescribed by Mr. Dale as "showing that the British working clause will work in the future." In fact, the passage quoted is from the statement of the British government regarding its policy in respect of German patents which, like other German property coming within the control of the British authorities upon the outbreak of the war, have been laid hold of by the government to abide the termination of hostilities. Mr. Dale's naïve assumption that what Great Britain is now doing to the property of the enemies with whom she is at war can afford a wholesome precedent for what the United States should do with the property of foreigners with whom we are not at war is, perhaps, the strangest delusion that the whole compulsory license dementia has yet produced.

What relation Mr. Dale bears to the textile industry, for which he presumes to speak, is not disclosed in his letter. To the credit of this industry it should be said that instead of seeking relief in the will-o'-the-wisp of compulsory license or compulsory working of patents, it is concentrating its attention upon tariff protection against "dumping" which is barely alluded to by Mr. Dale as one of the "other factors" involved in this problem. The hearings before the House Patent Committee last winter at which representatives of the textile industries appeared, and the recent report of the Secretary of Commerce on the dyestuff situation, seem to indicate that the more responsible leaders of opinion upon this subject are laboring under no such misconceptions as oppress Mr. Dale. J. N. V.

New York, N. Y.

### The Superheated Steam Unit

To the Editor of the SCIENTIFIC AMERICAN:

In the issue of March 27th, 1915, of the SCIENTIFIC AMERICAN, I think a mistake has been made on page 290. See third column, test No. 5. The sentence which begins in the twenty-second line from the top is as follows:

"The double superheat feature appears also in this locomobile, and as tested by the exposition judges it gave 8.70 pounds of coal and 1.02 pounds of steam per brake horse-power on a superheat of 649 deg. Fahr."

This statement might be very misleading to the uninitiated. Mr. Miller's article is both interesting and instructive, but it seems certain to me that the words "coal" and "steam" have been transposed. I have accepted the information with this assumption.

Jersey City, N. J. A. L. THURSTON, M.E., E.E.

---

**The "Roosevelt,"** Peary's Arctic ship, has been acquired by the U. S. Bureau of Fisheries and is to be used in connection with the work of that bureau in Alaskan waters. She was built expressly for Arctic service in 1905.

*Duc d'Abruzzi, Commander-in-chief Italian Fleet.*

**Displacement**, 22,000 tons. **Speed**, 23 knots. **Guns**: Thirteen 12-inch, eighteen 4.7-inch. **Belt**, 9¾-inch.

**Dreadnought "Guilio Cesare." Five ships in this class.**

# The Italian Navy

## The First Navy to Set Afloat Ships Combining High Speed With Heavy Guns

ALTHOUGH the Italian navy ranks as sixth in power among the leading navies of the world, it is absolutely first class in quality and its *personnel* is believed to be thoroughly efficient. Italian naval constructors have a reputation for originality and skill. Over a quarter of a century ago they launched two remarkable ships which were undoubtedly the forerunners of the modern battle-cruiser. They were known as the "Italia" and "Lepanto." They had the then unprecedented displacement of 14,400 tons and the then unrivaled speed for heavy-gunned ships of over eighteen knots. Each carried four 17-inch 100-ton breech-loading guns, and the bases of the smokestacks and the main battery were protected by armor of from 16 to 19 inches in thickness. A quarter of a century later it was that distinguished Italian naval officer, Cuniberti, who made the earliest, or one of the earliest, plans for a dreadnought battleship of large displacement, carrying an armament exclusively of big guns.

Commencing with the most important class of ships, the dreadnought, we find that Italy completed, in 1912, her first dreadnought, the "Dante Alighieri," a ship of 18,500 tons, designed for a speed of 23 knots, and carrying a main battery of twelve 12-inch 46-caliber guns and a torpedo battery of twenty 4.7-inch. The main battery is mounted in four three-gun turrets, all on the center line. The armor protection in this, as in all Italian dreadnoughts, is rather light, consisting of a 9⅞-inch belt and a 9- to 9½-inch protection for the main batteries.

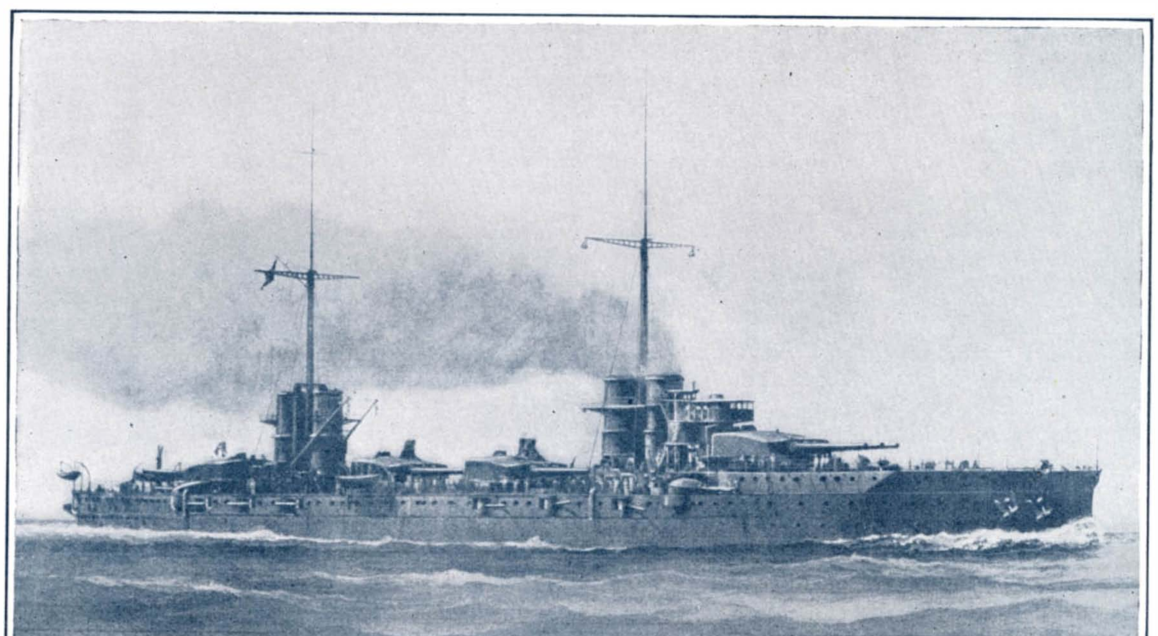
In 1914 the three dreadnoughts, "Conte di Cavour," "Guilio Cesare" and "Leonardo da Vinci," were added to the fleet. These ships, of a speed of 23 knots and of 22,000 tons displacement, are remarkable as being the first dreadnoughts to mount more than a dozen heavy guns, the main armament consisting of thirteen 46-caliber 12-inch guns, all mounted on the center line, as follows: Forward is a three-gun turret, astern of which and firing above its roof is a two-gun turret. Amidships between the two smokestacks is a three-gun turret, and aft are respectively, a two-gun turret and three-gun turret, the former firing above the roof of the latter. The belt and main gun position armor is, respectively, 9¾ inches and 9½ inches in thickness.

Italy is also generally credited with having completed two other ships of this class, the "Caio Duilio" and the "Andrea Doria." If the two last-named ships are completed, and it is probable that they are, Italy possesses a homogeneous squadron of six dreadnoughts, combining great offensive power with high speed. Well handled and properly fought, they should be capable of overwhelming the four Austrian dreadnoughts of the "Viribus Unitis" class.

Italy has laid down and is doubtless now pushing along to completion with all her available forces a class of four 25-knot battleships of the "Queen Elizabeth" class. The first of these, the "Christopher Colombo," gives her name to the class. They are to be of 30,000 tons and 25 knots speed, and the battery will consist of eight 15-inch and sixteen 6-inch guns. Particulars as to the armor protection have not been made public.

The Italian navy differs from any other in respect of its pre-dreadnought battleships; for the limited size, rather light armor protection, and comparatively light gun-fire of these ships would seem to place them more in the class of the armored cruisers than of the pre-dreadnought battleship. Most important of these are the four ships of the "San Giorgio" and "Pisa" classes, vessels of about 10,000 tons and 23 to 24 knots, protected with 8 inches of armor on the belt and main gun positions, and carrying four 10-inch and eight 7.5-inch guns, all mounted in two-gun turrets. These four ships were completed in 1909 and 1910. They could hardly stand up against the three semi-dreadnoughts of the "Ferdinand" class in the Austrian navy, which carry four 12-inch and eight 9.4-inch guns, but they would be a good match for the three ships of the "Karl" class, which mount four 9.4-inch and twelve 7.6-inch guns.

Next in point of age in the Italian navy are the three armored cruisers (or battleships, if you will) of the "Vittorio Emanuele" class of 12,625 tons and 21 knots speed, mounting two 12-inch 40-caliber and twelve 8-inch



**Displacement**, 18,400 tons. **Speed**, 23 knots. **Guns**: Twelve 12-inch, twenty 4.7-inch. **Belt**, 10-inch.

**Dreadnought "Dante Alighieri."**

45-caliber guns, the ships being protected by a 10-inch belt, with 8 inches on the main gun positions. These ships were completed in 1907-1908. Preceding these and completed in 1904 were the "Benedetto Brin" and the "Regina Margherita," of 13,500 tons and 20 knots, mounting four 12-inch and eight 8-inch guns, protected by a 6-inch belt and 8 inches on the main gun positions.

In 1901 the Italians built five armored cruisers of a type which found its way into other navies besides their own. They are readily distinguishable by their possession of a single military mast placed amidships and centrally between the two smokestacks. The first of these, the "St. Bon" and the "Filiberto," completed in 1901, are of 9,800 tons and 18 knots, and they mount four 10-inch in turrets, eight 6-inch in a central battery, and eight 4.7-inch behind shields. They are protected by a belt of 9¾-inch nickel steel, with the same thickness on the barbettes. The other three, "Garibaldi," "Varese" and "Francesco Ferruccio," of 7,400 tons, carry one 10-inch and two 8-inch guns, and have 6 inches of armor on the belt and bow decks.

Of older armored ships built between 1887 and 1891, Italy has three battleships of the "Re Umberto" class, of 13,250 tons, mounting four old 13.5-inch, six old-type 6-inch, and sixteen 4.7-inch guns. They are good only for coast defense or the bombardment of coast fortifications, such as is being done by the other armored ships of the Allies at the Dardanelles.

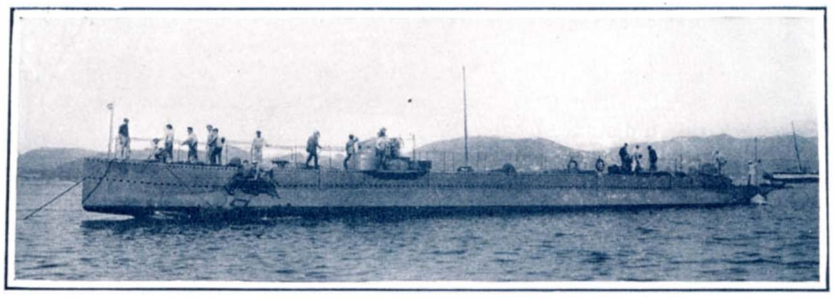
The "Carlo Alberto" and "Vettor Pisani," completed some sixteen years ago, are armored cruisers of 6,500 tons, mounting twelve 6-inch and six 4.7-inch guns. Their present speed is about 18 knots.

Of fast scouts, Italy possesses four of about 3,500 tons and 28 knots speed, carrying a main armament of six 4.7-inch guns. She has eight or ten light cruisers varying in displacement from 2,200 tons to 3,800 tons, and in speed from 18 to 22 knots. Her navy includes also half a dozen gunboats of from 20 to 23 knots speed.

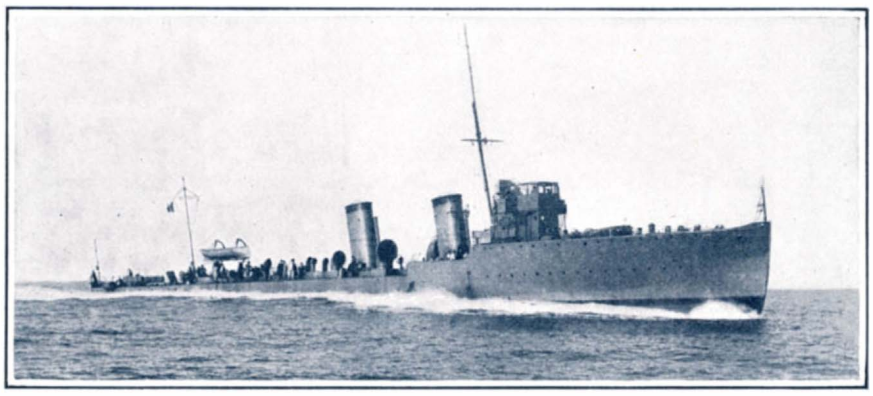
The destroyer fleet of the Italians is first-class in quality and it is believed to be very capably handled. Built and building, it includes about fifty vessels varying in size from 300 to 1,500 tons, and in speed from 28 to 32 knots. The 1,500-ton vessels are under construction, as are also three of 1,000 tons and ten of 770 tons. Of mine layers, Italy possesses three vessels of 850 tons and 20 knots speed.

The Italian submarine fleet includes about a score of vessels completed and, as far as is known, about a dozen under construction. The "Argo" class of about 300 tons displacement are credited with a surface speed of 18 knots and an under-water speed of 14 knots.

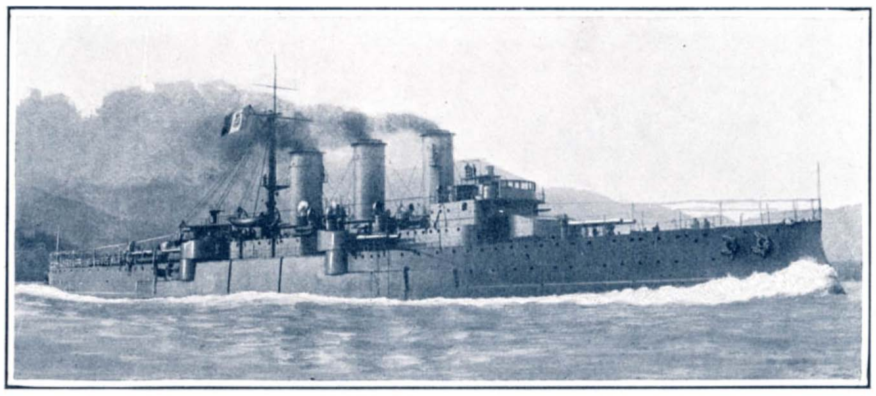
The total strength of the Italian navy in officers and men is about 38,000.



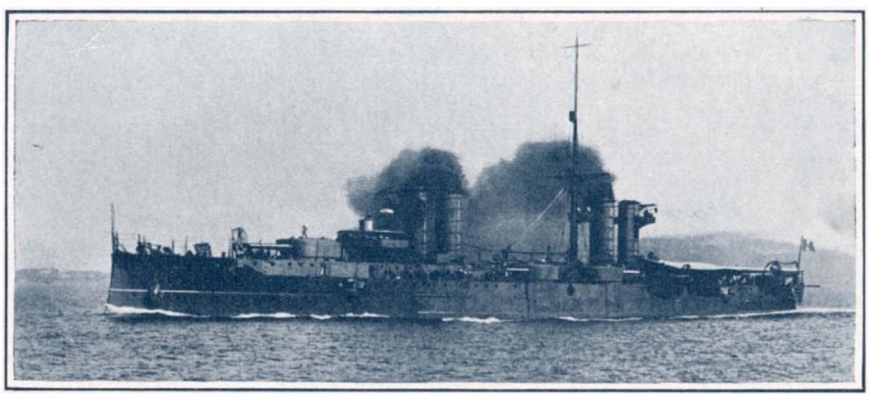
**Displacement,** 400 tons. **Speed,** 13 surface knots, 9 submerged knots. **Torpedo tubes,** 2.
**Submarine "G. Pullino."**



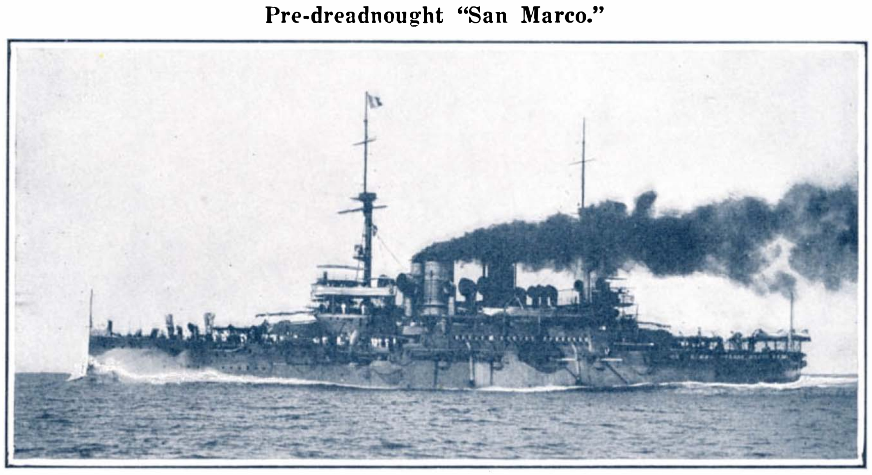
**Displacement,** 700 tons. **Speed** on trial, 36 knots. **Guns:** One 4.7-inch, four 3-inch. **Torpedo tubes,** 2.
**Destroyer "Audace."**



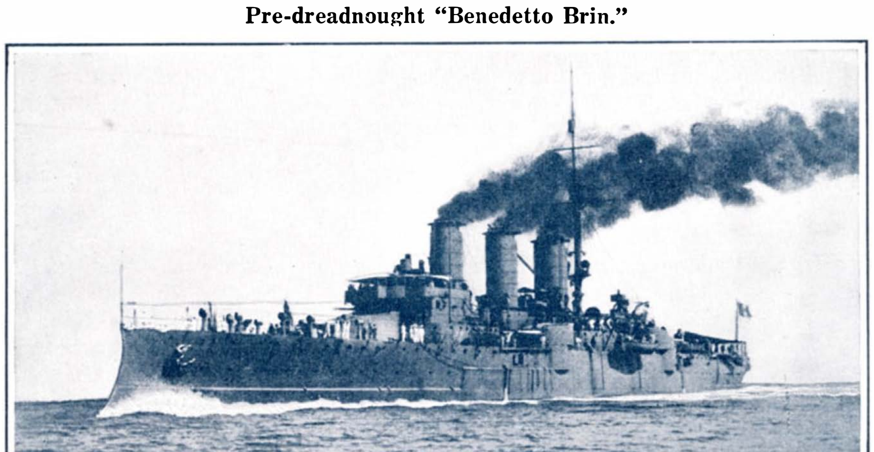
**Displacement,** 11,000 tons. **Speed,** 22½ knots. **Guns:** Four 10-inch, eight 7.5-inch. **Belt,** 8-inch.
**Pre-dreadnought "Pisa."**



**Displacement,** 10,000 tons. **Speed,** 24 knots. **Guns:** Four 10-inch, eight 7.5-inch. **Belt,** 8-inch.
**Pre-dreadnought "San Marco."**



**Displacement,** 13,500 tons. **Speed,** 20 knots. **Guns,** Four 12-inch, four 8-inch, twelve 6-inch. **Belt,** 6-inch.
**Pre-dreadnought "Benedetto Brin."**



**Displacement,** 11,000 tons. **Speed,** 23½ knots. **Guns:** Four 10 inch, eight 7.5-inch. **Belt,** 8-inch.
**Pre-dreadnought "Amalfi."**

## Classification of Technical Literature

DELEGATES from about twenty national technical and scientific societies met in the United Engineering Society Building, New York, on May 21st, 1915, to perfect a permanent organization for the purpose of preparing a classification of the literature of applied science which might be accepted and adopted by organizations generally.

There was a generally expressed opinion that such a classification, if properly prepared, might well serve as a basis for the filing of clippings, for cards in a card index, and for printed indexes; and that the publishers of technical periodicals might be induced to print against each important article the symbol of the appropriate class in this system, so that by clipping these articles a file might be easily made which would combine in one system these clippings, together with trade catalogues, maps, drawings, blue prints, photographs, pamphlets and letters classified by the same system.

Mr. W. P. Cutter, the librarian of the Engineering Societies' Library, read a paper on "The Classification of Applied Science," in which he stated that no one of the existing classifications was complete and satisfactory enough to be worthy of general adoption. He outlined a plan whereby a central office could collate all the existing classifications, and, with the help of specialists in the various national societies interested, might compile a general system which might meet with general acceptance and adoption.

Permanent organization was effected, and it was agreed that a special invitation to participate by the appointment of a delegate be sent to other national societies which might be interested in the general plan.

The name adopted for this organization is "Joint Committee on Classification of Technical Literature," and the temporary address of the secretary, Mr. W. P. Cutter, is 29 West Thirty-ninth Street, New York city.

## Prizes for Discoveries Relating to Alcohol

THE Russian Ministry of Finance is offering a series of prizes for inventions relating to the use of alcohol, and covering a varied field of investigation. The various prize offers are as follows: Three prizes of 30,000, 15,000, and 5,000 rubles for a satisfactory method of denaturing alcohol. Three prizes of 60,000, 30,000, and 10,000 rubles for a new product derived from alcohol. Three prizes of 50,000, 20,000, and 5,000 rubles for a new method of applying alcohol to the preparation of a product in which it, or its derivatives, constitute a part. Three prizes of 30,000, 15,000, and 5,000 rubles for new methods for the application of alcohol in an industry in which the spirit, or its derivatives, serve as a transitory dissolving agent, or an extracting or precipitating substance. Four prizes of 75,000, 50,000, 30,000, and 20,000 rubles for an apparatus for utilizing alcohol for feeding internal combustion engines. Four prizes of 75,000, 50,000, 30,000, and 20,000 rubles for improvements in apparatus relating to utilizing alcohol, or its derivatives, as fuel. Four prizes of 50,000, 30,000, 15,000, and 5,000 roubles for apparatus for applying alcohol to lighting purposes. The declarations relating to these competitions must be filed not later than January 1st, 1916, with the Department of Unassessed Taxes and Spirit Monopoly (Glavnoe Oupravlenie Neokladnich Sborow i Casenoï Prodagy Piteï, Petrograd). It may be noted that a ruble is equivalent to about 51 cents of our money.

## A New Burglar-proof Safe

A RECENT report from the American Consul at Nuremberg, Germany, announces that the famous Krupp Works at Essen have discovered a burglar-proof safe which will "put all the burglars to shame." The discovery consists in the production of a steel which will withstand the attacks of the oxyacetylene flame, and that it will be impossible to burn a hole through the safe with the acetylene flame either in the time at his disposal or the amount of acetylene and oxygen which the burglar could carry to his base of operations.

At a melting test it required one and one quarter hours of burning and used up 176 gallons of acetylene and 534 gallons of oxygen to burn a hole 1 9/10 inches in diameter and 1 4/10 inches deep into the plate. Such an operation did not burn an opening which would allow the hand to be inserted.

In order to produce a hole large enough to admit the hand, the operation requires six hours of time and 2,400 gallons of acetylene and 2,600 gallons of oxygen. This would require 600 pounds of raw material for the burglar's operation besides requiring almost the whole night to burn through a plate 2 inches thick.

The steel from which the safe is constructed is so hard that it cannot be bored and tapped and all screws and rivets must be made and cast with the plates.

## The Westinghouse Electro-pneumatic Air Brake on the Pennsylvania Railroad

By Herbert T. Wade

THE Pennsylvania Railroad has adopted as standard equipment for all its new passenger trains the Westinghouse electrically controlled air brake, and the cars now in service are being supplied with it as fast as circumstances and funds available for such betterment allow. This important step is being undertaken only after an elaborate series of tests under actual service conditions carried on for several months with a complete train of twelve passenger cars and a modern steam locomotive. These tests demonstrated conclusively that with the new equipment it was possible to secure much quicker and more effective stopping, both in case of emergency and under ordinary conditions, as slowing down for a station or reducing speed on a down-grade with a corresponding increase of safety and economy in handling traffic. Not only were the advantages of the new arrangement demonstrated, but there was accumulated a mass of data dealing with the general questions of the theory and use of air brakes, derived from systematic study, in which the train equipped with special measuring and recording instruments of high precision, was virtually a scientific laboratory for the engineers and other experts of the Westinghouse Air Brake Company and the Pennsylvania Railroad.

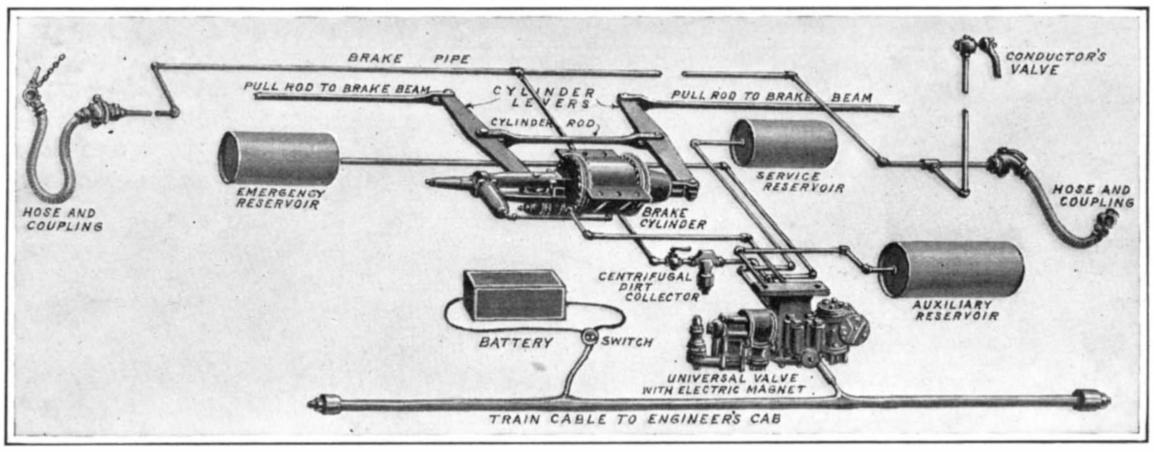
Though various trials of improvements in air brakes and air brake equipment have taken place from time to time, not since the Galton-Westinghouse tests in England in 1878 had such extensive and scientific brake investigation been made. When it is stated that the number of these brake tests aggregated 691, and that they extended from February 10th to the end of May, 1913, their extent and character may be appreciated, as well as the amount of data accumulated for subsequent consideration in connection with almost every phase of the air brake problem. These results were then discussed by the engineers of the railroad and in their recommendation the decision to install the improved equipment was made, and this work is now in progress.

That improved air brake equipment is desirable in the interest of safety and more efficient operation is evident by a consideration of the change in conditions attending the development of the air brake. In the year 1890, with a train weight of 280 tons running at a speed of 60 miles per hour, the energy to be dissipated was about 33,000 foot-tons and the stopping distance with the application of the brakes was 1,000 feet. In the year 1913, with a train weight of 920 tons, running at this speed of 60 miles per hour, the energy dissipated was 111,000 foot-tons, almost four times greater than that of the train first mentioned. Now, if the second train was equipped with a brake of the same class as that of the former, the stopping distance would be 1,760 feet and its collision energy when it passed the 1,000-foot mark where the first train would have stopped would still be 48,000 foot-tons, or one and one half times as much as the 1890 train had when the brake was applied, with still 760 feet to run. With the latest improvement in the air brake such a train can now be equipped with the new brake apparatus so that it can be stopped in 860 feet, at which point with the old brake it would have been running at 43 miles per hour and with a collision energy of 57,000 foot-tons, or still about twice that contained in the train of 1890 at the beginning of the stop. In fact, the energy that must be dissipated by the air brake on a modern train with modern speeds of travel has increased eighty-fold since the original invention of the air brake. Looking at the matter in another way the problem may be stated as follows: To bring the speed of a train of twelve cars up to 80 miles an hour a distance of from 8 to 12 miles is required for such an acceleration, and the production of an amount of energy which must be dissipated in a few seconds in order to stop the train within a distance of approximately 2,000 feet.

The important advantages that now figure in the Pennsylvania equipment were secured by improvements both in the effectiveness of the brake as a whole, as well as in detail. By the brake is meant not only the triple valve fundamental to the Westinghouse air brake, but the entire mechanical organization and assembly of the various elements. Improvements were made in the efficiency of the braking system as a whole, and also in the automatic and manual control of the brake operated, this function, naturally, being rendered more difficult by the increasing lengths of trains. But before any such innovation could be made on a large scale it was necessary that it should receive a complete and thorough test under actual working conditions. This was done on the Pennslvania Railroad, employing a train of twelve steel passenger cars and a modern locomotive, weighing nearly 1,000 tons and about 1,000 feet in length, on a special section of track on the West Jersey and Seashore division of the Pennsylvania system, near Absecon. The locomotive and cars are fitted with the new mechanism, which, in its most improved form, aside from the principle of operation concerned, involved also the use of two shoes per wheel as higher retarding forces could be developed than were possible with a shoe on only one side of the wheel, on account of the limits of excessive piston travel, of brake shoe wear and distortion producing variable results of unequalized strains in brake, and of journal troubles.

In the improvement and perfection of the air brake many elements successively have been added until to-day the mechanism, while increasingly effective, is of considerable complexity. For example, with long trains with the older systems there would be delay in the application of brakes at the rear, and there would be unevenness and shock in stopping. Due to the delay incident in the mechanical operation of the system the stopping distance at high speeds and with heavy loads and long trains could not hitherto be reduced as was desired in the interest of safe and effective operation. The new system secures immediate action at each triple valve by substituting therefor a universal control valve, where not only are all the essential features of the air control included, but also there is incorporated an electric system whereby the braking mechanism at the rear end of a long train, or at any car, in fact, does not have to wait an appreciable amount of time for the difference in pressure to be realized, but the valves are opened or closed by local electro-magnets energized from a battery circuit in each car.

The electro-pneumatic equipment is arranged so that when operated electrically the service application of the brakes is actuated by a reduction in brake pipe pressure as when operated pneumatically. The electric effect is the same as the pneumatic effect and the electric valves operate the pneumatic valves in similar fashion, only the response is made immediately—the electro-magnetic valves responding more promptly. The release magnets are controlled by the brake valve handle in either release or holding position, and with an electro-pneumatic emergency application the emergency magnets on all cars simultaneously and instantaneously energize and open their respective emergency magnet valves, which, in turn, cause the quick action parts of each universal valve to operate and produce an emergency application of the brakes. If the hose bursts or a conductor's valve, familiarly seen in a passenger car, is opened, the first universal valve to be affected by the resulting drop in brake pipe pressure will operate pneumatically and close its emergency switch so that the emergency magnet circuit throughout the train is energized and an electric emergency application on all brakes obtained.




**Schematic representation of electro-pneumatic air brake installed on a passenger car.**

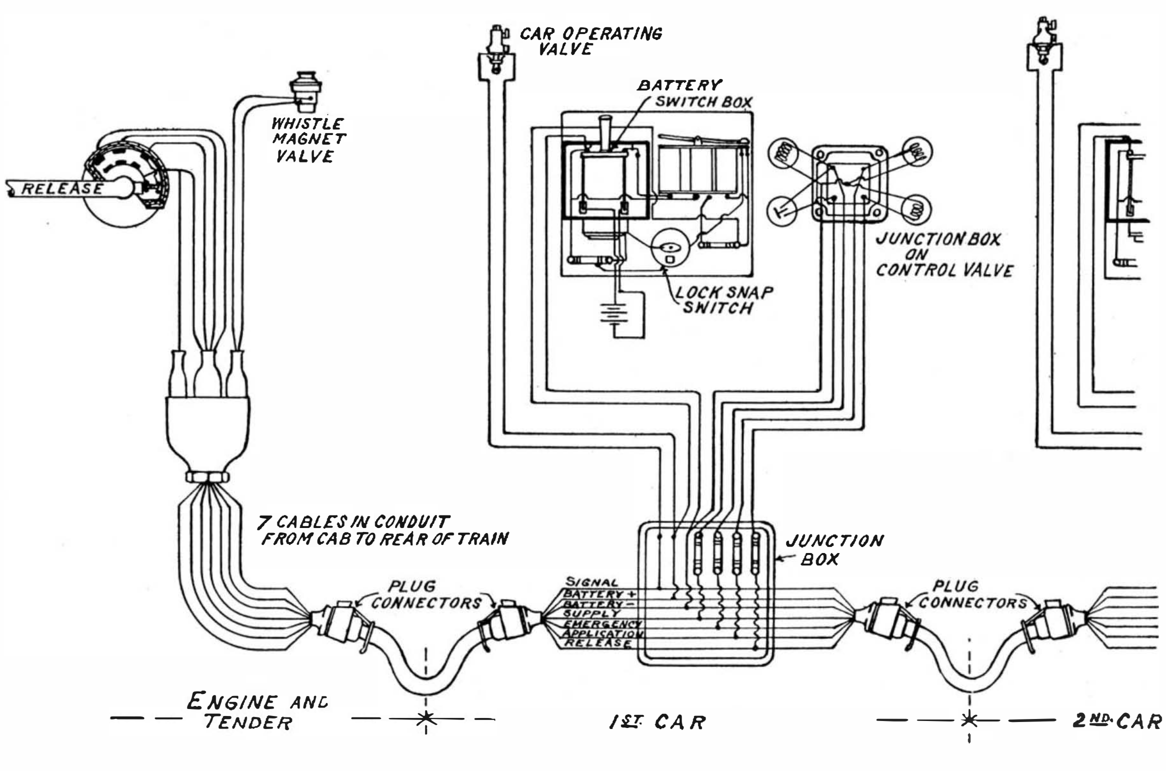



**Diagram of wiring and connections for electric control of air brake.**

The new system, which at first examination is quite complicated, both by its arrangement of electric connections and the arrangement of valves and magnets, secures now the application of the air brakes more quickly, also giving increased emergency stopping power, and enables the use of a higher pressure which may be held without diminution toward the end of a stop, while at the same time a more efficient design and better installation of foundation brake rigging has been adopted so that both the application and release of the brakes is more positive and reliable in all its operations. The new system, as stated, employs two shoes per wheel which is known as the "clasp brake," and it is arranged to operate so that the time of obtaining the maximum emergency brake cylinder pressure on the train as a whole, according to the official tests, was shortened from eight seconds with the best previous equipment to 3.3 seconds with the improved apparatus; and when the electric control, which was a further feature of the new system, was used, this could be diminished to 2.25 seconds. The electric system is controlled from the engineer's valve without extra levers or switches, the electrical mechanism being connected with the simple control valve, the circuits being arranged within. The system also works automatically in case of any failure along the line, and there results a simultaneous application of just as great retarding forces with the elimination of all violent slack action and shock.

With the universal control a train of twelve steel cars and locomotive with the electro-pneumatic brake, 150 per cent braking power, clasp brake rigging, unflanged brake shoes, can be stopped:

From 30 miles per hour in 200 feet equivalent to an average retarding force of 300 pounds per ton.

From 60 miles per hour in 1,000 feet equivalent to an average retarding force of 240 pounds per ton.

From 80 miles per hour in 2,000 feet equivalent to an average retarding force of 214 pounds per ton.

It would seem, therefore, that here we have an important step forward toward increase of safety and that increased speeds may be used with proper safety, while greater density of traffic can be permitted under good conditions of operating that will give increased returns.

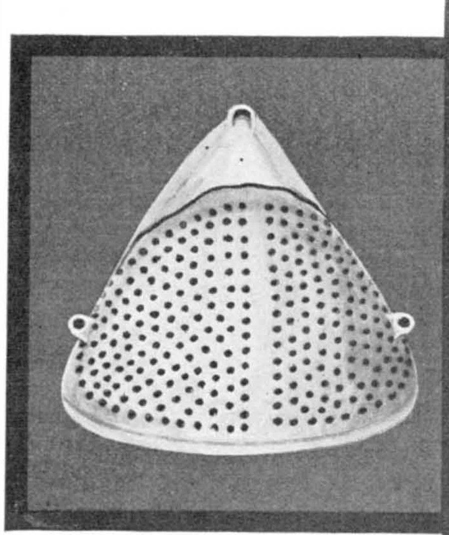


Fig. 1.—Respirator capable of being used with absorbing chemicals.

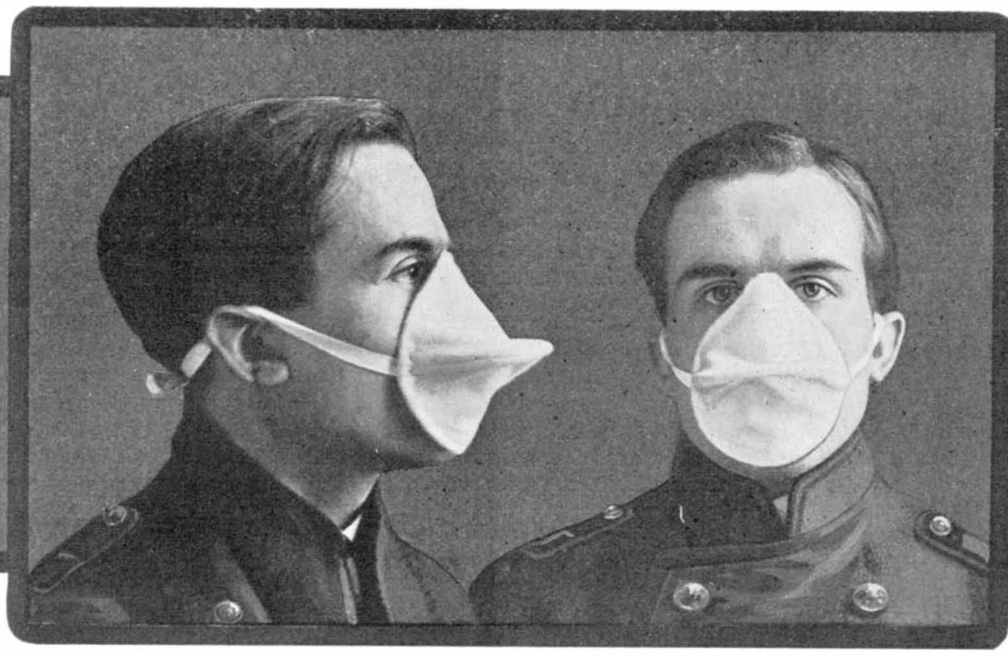


Fig. 2.—Two views of a French type of flannel muzzle.

Fig. 3.—Italian respirator provided with exit valve for exhaled air.

# The Use of Poisonous Gases in Warfare

## How Gases Are Generated and How Men May Protect Themselves From Them

By John B. C. Kershaw, F. I. C.

THE earliest use of deleterious gases in siege warfare is recorded in the history of the Peloponnesian wars from 431 to 404 B. C. During this struggle between the Athenians and Spartans and their respective allies, the cities of Platea and Delium were besieged. Wood saturated with pitch and sulphur was set on fire and burnt under the walls of these cities, in order to generate choking and poisonous fumes, which would stupify the defenders and render the task of the attacking forces less difficult. Another form of the same method of attack used about this date was to fill a cauldron with molten pitch, sulphur, and burning charcoal, and to blow the fumes with the aid of a primitive form of bellows and air-blast, over the defenders' lines.

Greek-fire, about which much was heard in the wars of the middle ages, was a liquid, the composition of which is now unknown, that was squirted through the air, and was used for setting fire to the buildings or places attacked. It was employed chiefly in sea-fights in order to set fire to the ships of the enemy, and it was used by the Byzantine Greeks at the sieges of Constantinople in the years 1261 and 1412.

Turning now to the application by the Germans of poisonous gases to trench warfare, we have the following official descriptions of the character and appearance of the gases, and of their effects:

Sir John French, in his report, dated May 3rd, asserts that "the gases employed have been ejected from pipes laid in the trenches, and also produced by the explosion of shells especially manufactured for the purpose. The German troops, who attacked under cover of these gases were provided with specially designed respirators, which were issued in sealed pattern covers. This all points to long and methodical preparation on a large scale.

"The effect of this poison is not merely disabling or even painlessly fatal, as suggested in the German press. Those of its victims who do not succumb on the field, and who can be brought into the hospital suffer acutely, and in a large proportion of cases die a painful and lingering death.

"Those who survive are in little better case, as the injury to their lungs appears to be of a permanent character, and reduces them to a condition which points to their being invalids for life. These effects must be well-known to the German scientists who devised this new weapon, and to the military authorities who have sanctioned its use."

The following description, given by a British officer and published in the daily papers, shows the effects of the poison gases upon the men who survived them, and were carried into the hospital:

"When we got to the hospital we had no difficulty in finding out in which ward the men were, as the noise of the poor devils trying to get breath was sufficient to direct us. We were met by a doctor belonging to our division, who took us into the ward. There were about twenty of the worst cases in the ward on mattresses, all more or less in a sitting position propped up against the walls. Their faces, arms, and hands were of a shiny grey-black color, with mouths open and lead-glazed eyes, all swaying slightly backward and forward trying to get their breath. It was the most appalling sight, all these poor black faces struggling, struggling for life."

Dr. J. S. Haldane, F.R.S., who was sent out to France to investigate the effects of these gases, and to report upon the best methods of protection, states that:

"The symptoms and the other facts, so far ascertained, point to the use by the German troops of chlorine or bromine for purposes of asphyxiation. There are also facts pointing to the use in German shells of other irritant substances, though in some cases at least, these agents are not of the same brutally barbarous character as the gas used in the attack on the Canadians. The effects are not those of any of the ordinary products of combustion of explosives. On this point the symptoms described left not the slightest doubt in my mind."

British soldiers prepared to weather a gas attack.

A deposition by Capt. Bertram of the Eighth Canadian Battalion states that: "On Thursday, April 22nd, he was in a support trench, about 600 yards from the German lines, when he saw first of all, a white smoke rising from the German trenches to a height of about 3 feet. Then in front of the white smoke appeared a greenish cloud, which drifted along the ground to our trenches, not rising more than about 7 feet from the ground, when it reached our first trenches. Men in these trenches were obliged to leave, and a number of them were killed by the effects of the gas."

The last description indicates that the gases used in this attack were a mixture of sulphurous acid and chlorine. The former is a dense white gas and the latter is green—both gases are heavier than air and would therefore, creep along the ground—and they can be generated cheaply, in large quantities in the trenches, by comparatively simple means. Both gases are asphyxiating when breathed even in a dilute state—and when inhaled without much air dilution they would produce the effects upon the lungs that have been already described. As regards the methods of generating these gases, the sulphurous acid gas was probably made in the trenches by the simple expedient of throwing sulphur into open braziers containing charcoal or coke fires, while the chlorine was very probably brought to the trenches compressed under 5 atmospheres (or 76 pounds) into liquid form, in large steel cylinders similar to those used for compressed oxygen and hydrogen gases. The electrolytic method of decomposing common salt and producing caustic alkali is widely developed in Germany, and the chlorine liberated by this process has been, in the past, somewhat of a drug on the German chemical market. Quite possibly large stocks of chlorine gas in liquid form have been accumulated in Germany in recent years in view of this war, but the German military authorities in any case will have ample reserves of their latest form of ammunition ready to their hand, in the salt deposits of Stassfurt and elsewhere. Having brought a sufficient number of the cylinders of compressed chlorine to the trenches, it is merely necessary to insert a delivery pipe through the outer wall or parapet of the trench, to connect this to the cylinder, and then to wait for a favoring wind before turning on the gas tap, and allowing the gas to escape from the cylinder under its own pressure.

Since the liquefaction pressure of chlorine is so low, a very large number of gas cylinders would be required to transport a large volume of gas to the trenches where it was to be employed, but this would not prove an insuperable obstacle to an army well provided with motor transport.

Considering now the means of defence against sulphurous acid and chlorine gas, one must note first that neither gas is poisonous in the sense that carbon monoxide gas is poisonous, that is neither gas forms a poisonous compound with the corpuscles of the blood. The gases are poisonous in the sense that they produce death by asphyxiation or by producing irritation and inflammation of the bronchial tubes and lung tissues, and if these gases are well diluted with air before they are inhaled, their permanent poisonous effect is greatly reduced.

Turning now to the practical question of the means of defence against poisonous gases, these may be divided into two broad classes, according as they depend upon chemical or mechanical principles of removing the gases from the air.

The first form of respirator, supplied to the British troops in Flanders, belonged to the former class, and was based upon a pattern supplied by the Admiralty. Over a million of these respirators (made by voluntary labor), consisting of a covering for the mouth and nose of stockinette lined with cotton-wool, were sent out toward the end of April. These respirators, however, have not proved efficacious in warding off the evil effects of the gases when these latter have reached the trenches in a fairly condensed form, and Dr. Haldane has been sent out again to Flanders to experiment with various forms of larger respirators and head coverings of helmet shape, in which cotton wool or cotton waste

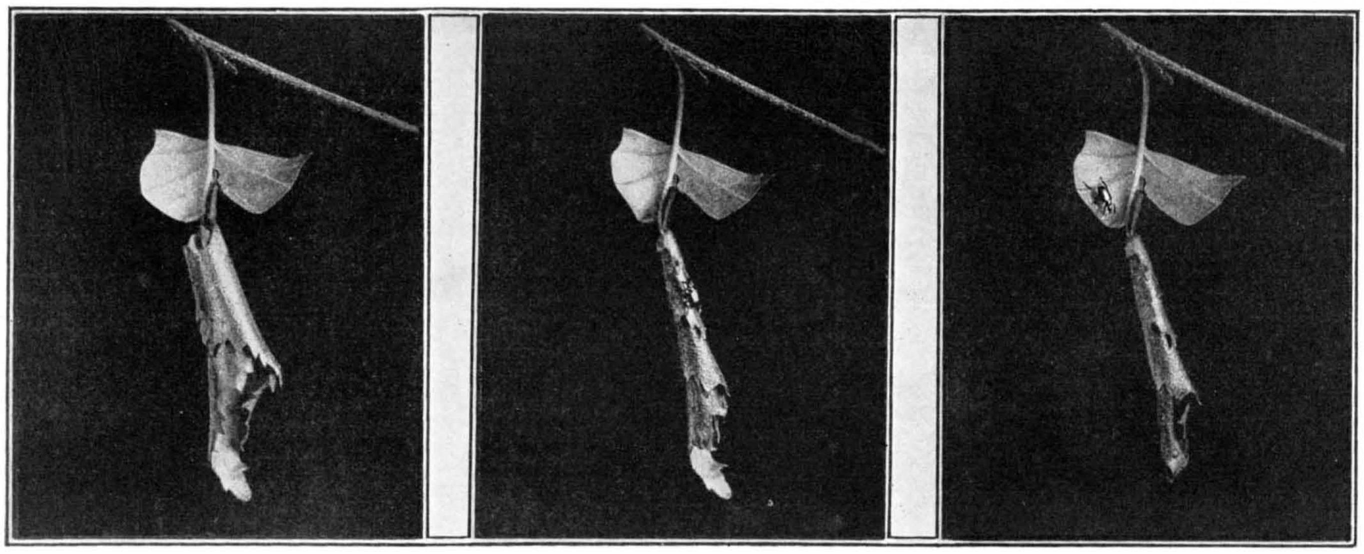
(Concluded on page 598.)

# A Study in Instinct

## The Leaf Roller and Its Writhings

By Harold Bastin

WHAT is instinct? We do not know. Yet we frequently make use of the word, usually to express our recognition of the fact that many animals are governed in their behavior by inward promptings which are not the outcome of intelligence. An animal follows a course of instinctive action because it must—not because it has deliberately chosen that course with the object of attaining some definite end. This point calls for strong and frequent emphasis by serious students of psychology, since many popular writers on natural history falsely endow their beasts and birds with a complete set of human faculties and emotions, thus mystifying the general public. Naturally, it is not always easy in a given case to determine exactly where instinct ends and intelligence begins; but our difficulties in this respect can only be increased by a careless use of terms and a misrepresentation of ascertained fact.



Final successive stages of the leaf rolling, consisting of tightening and closing the leaf. In the second view the weevil is engaged in fixing down the overlap, and in the last view she has tucked in the leaf tip, and is about to partially sever the midrib, as described in the text.

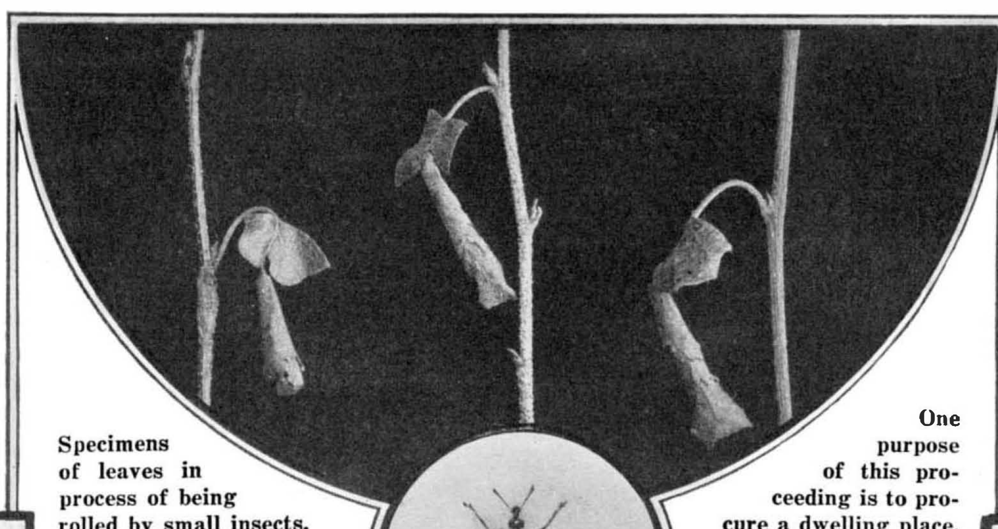
The easiest way to grasp the significance of the word *instinct*, as employed in the scientific sense, is to examine critically an actual case in point. Cases of pure instinct occur most commonly among insects; and for our present purpose we may consider briefly the activities of certain small weevils which are grouped by naturalists in the families *Rhynchitidæ* and *Attelabidæ*. These insects are known popularly as "leaf-rollers," because the females, at the period of egg-laying, prepare leaves in an elaborate manner to serve as food and dwelling-places for their young. Both families are represented in the American continent; but in Europe the species are much more numerous, and one (*Rhynchites bacchus*) ranks as a "pest," because it sometimes mutilates vine leaves in such numbers as seriously to hamper the growth of the plants.

These weevils cut and roll their leaves in characteristic ways, according to the species, and frequent different kinds of plants. The subject of this article (*Rhynchites betulæ*) occurs most commonly on the birch. Let us suppose that we have before us one of these insects, and that she is about to commence work upon a leaf. In the first place she does much prospecting, moving deliberately about, both upon the upper and under surfaces of the leaf. If satisfied with her investigations, she at length makes her way to a point at the edge of the leaf, not far from the stalk, and standing upon the upper surface, cuts the substance with her jaws in a long curve from the edge to the midrib. She then ascends the leaf for a short distance, and from the other side of the midrib makes another curving cut to the opposite edge.

In favorable circumstances, the two cuts are made in from ten to fifteen minutes. Then comes a lengthy pause, presumably that the leaf may wilt and thus become sufficiently flexible for the work that is to follow. It is important to realize that the cuts made by the beetle are conducted on highly satisfactory mathematical principles, being exactly such as are needed to render the subsequent rolling of the leaf most easy to accomplish. Should the insect fail to project her curves with accuracy, she would fail also to roll up the leaf.

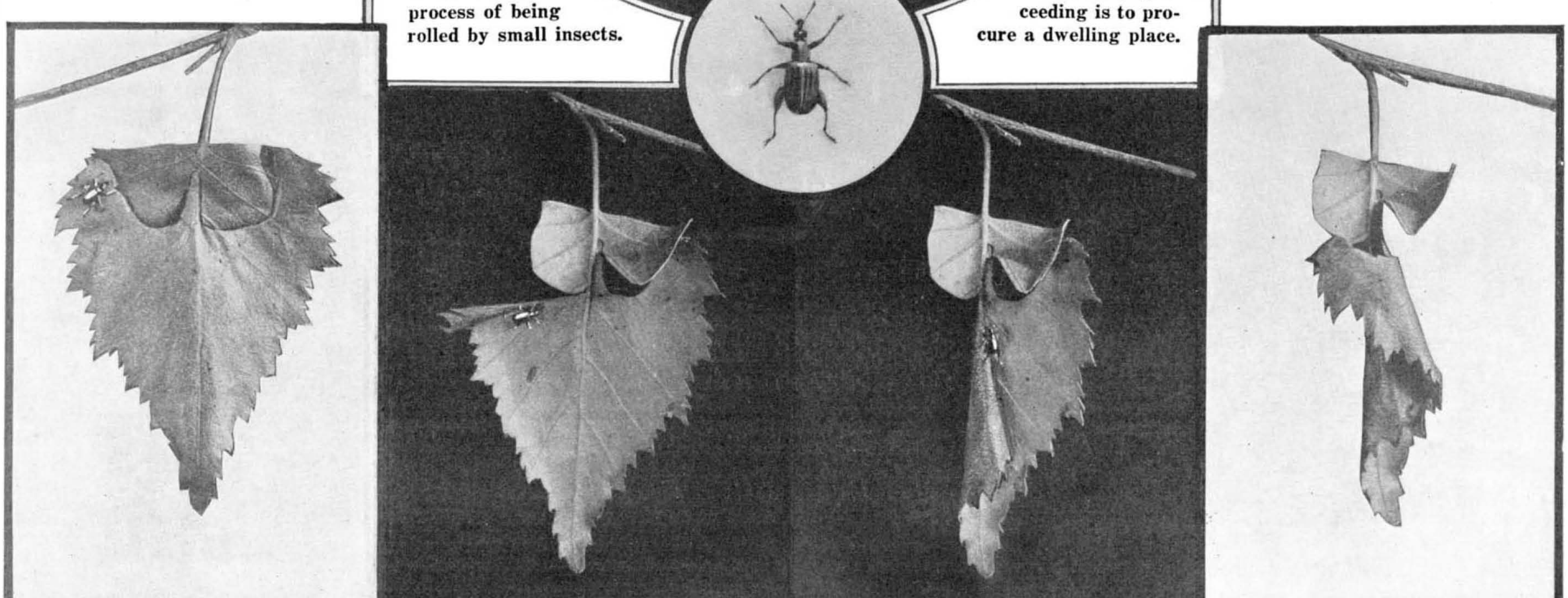
When the leaf has become sufficiently pliable the weevil goes to its under surface, and standing close to the edge where her original cut begins, commences to roll the severed portion round an ideal axis by means of her legs. Having reached the midrib, she alters her tactics somewhat, now drawing the second half of the leaf round the first, with the result that she herself is soon inclosed in the folds. At about this stage she makes several incisions in the leaf substance and lays an egg in each. Thereafter she comes forth, tightens the roll, and fastens the overlap with her jaws. Then she makes a small, separate roll of the leaf tip, and bends it inward so as to close the end of the main roll. Then, finally, she ascends the leaf, and partly cuts through the midrib at the point where her first curve meets it. This she appears to do in order to promote the particular state of decay in the leaf which will render it fit food for the grubs. The above is the briefest possible description of what this insect does—not once, but many times in the course of her adult life. If we examine her work in detail, take measurements, and consider the well-ordered sequence of her various actions, our first impulse is to exclaim: What amazing cleverness and skill! Yet when we trace the life-cycle of the insect, we are forced to admit that such praise is unmerited. The eggs, which hatch in the rolled-up leaf, produce blind and legless maggots. These feed upon the decaying leaf tissue around them, and when full grown allow

(*Concluded on page 598.*)



**Specimens of leaves in process of being rolled by small insects.**

**One purpose of this proceeding is to procure a dwelling place.**



The central figure is the leaf-rolling weevil (*R. betulæ*), much magnified. In the lower illustrations, that at the left shows the leaf-rolling weevil on the upper side of a birch leaf, which she has just finished cutting. The other three views show successive stages in the work of rolling the leaf. It will be observed that she works from the under side of the leaf. The eggs are laid when the last stage here shown is reached.

**A study in instinct.**

## RECENTLY PATENTED INVENTIONS

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

### Pertaining to Apparel.

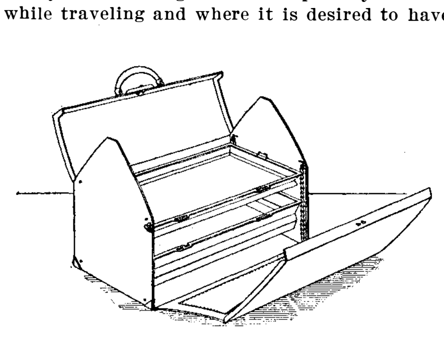
RESILIENT CONNECTING DEVICE.—J. P. WILSON, 800 W. 8th St., Los Angeles, Cal. Resilient means provide for connecting two members or articles, such as for attaching suspender parts to trousers, or for use in or with garment supports, or trusses, or other articles of wear involving the yielding connection of two articles or members, or the attaching of one article to another, whereby the connecting means will be under tension.

SHOE HEEL.—L. F. HERING, General Delivery, Pomona, Cal. The inventor provides a cushion heel, including a pair of telescoping members having a coil spring interposed between them, one of the members being adapted to engage the ground in walking and telescope within the other against the action of the spring, said members being so formed as to prevent displacement one from the other.

HAT PATTERN.—LYDIA K. WHEELOCK, 47 Clearemont Ave., New York, N. Y. This invention refers to hat patterns for hat structures for ladies' wear, and more particularly to hats made in various designs for such patterns, and the invention further comprehends an improved pattern and method of designing the same as well as generally an improved system of constructing hats for such patterns.

BATHING CAP.—ELSIE HILLER, 114 W. 32nd St., New York, N. Y. The invention provides a cap having ornaments attached thereto; provides a cap with ornaments impervious to water; provides a cap constructed from elastic material adapted to conform to the shape of the head of the wearer; and provides a decorated cap, the ornaments whereof are held in position by being adhered to the structure without perforating the same.

DRESSER VALISE.—G. COHN, 122 W. Bunett St., Louisville, Ky. The invention relates to improvements in valises and more particularly to one designed more especially for use while traveling and where it is desired to have



DRESSER VALISE.

a sufficient quantity of clothing and accessories conveniently and compactly arranged to render the same readily accessible and without the usual inconvenience experienced in the use of the ordinary style of valise or handbag.

MEANS FOR ATTACHING COLLARS AND OTHER NECKWEAR TO SHIRTS.—B. JOACHIM and B. DAVIDSON. Address the former, 66 Arsdale Terrace, E. Orange, N. J. This invention constitutes a tangible element carried by the neck band of a shirt and an intangible element carried by the collar or neckwear for convenient attachment and removal of the collar at the back of the neck band, thus providing space for the free sliding of the tie, as well as avoiding the use of buttons.

BATHING CAP.—H. P. RINDSKOPH, 397 Sumner Ave., Brooklyn, N. Y. This invention provides a cap which may be placed in wearing position and removed therefrom without disarranging the hair; provides a retaining device for a cap which may be installed without injuring the arrangement of the hair; and reduces the cost and simplifies the construction of the cap.

### Pertaining to Aviation.

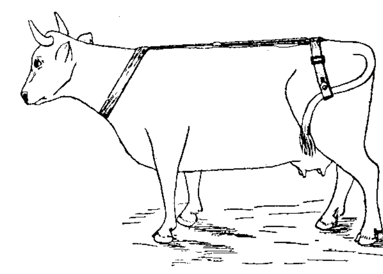
PROJECTILE FOR DESTROYING AIRSHIPS, BALLOONS, AND OTHER AEROSTATS.—R. A. FEATHERSTONE-SMITH and M. B. COOPER. Address Day, Davies and Hunt, 321 High Holborn, London, W.C., England. The invention is characterized by constructing the projectile with one or more passages for gas from the airship gas bag and outside air to pass along to form an explosive mixture in the bag or inner outer envelopes of the airship and in the projectile, by adapting the projectile for automatically igniting the explosive mixture to destroy the airship, by providing the projectile with means for forcing a blast of air into the gas bag of the airship to hasten the production of the explosive mixture, and by adapting the projectile with means for limiting its penetrations into the gas bag of the airship.

### Of Interest to Farmers.

EGG CONTAINER.—W. H. LEWIS, L. B. 28, Arrington, Va. Objects of the improvement are to provide a container having cells adapted to conveniently receive separately wrapped eggs; and to provide cells in which eggs will be fully protected against breakage by the ordinary shocks or pressure to which they are subjected in transit, particularly in shipping by parcel post.

COTTON HULLER.—J. C. CONRAD, Cement, Okla. An object of this invention is to provide a device by means of which the cotton may be thoroughly cleaned of the hulls, the former being passed from the machine, and the latter also being conveyed away from the interior of the machine.

COW'S TAIL HOLDER.—E. QUICK, Trinidad, Colo. The main object of the invention is to so secure the tail of a cow that the animal may not switch its tail in an effort to rid itself of insects, such as flies, mosquitos, gnats, etc. It is well known that cows switch their tails continually, either to brush off insects, or from

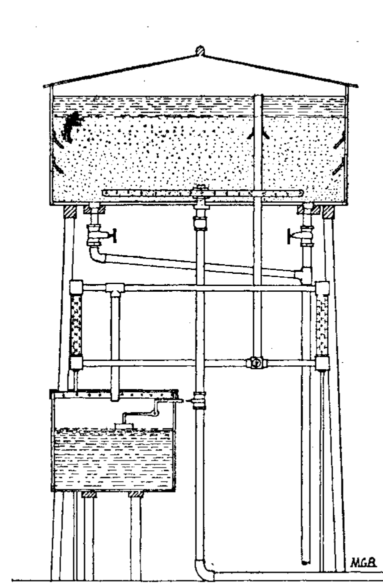


COW'S TAIL HOLDER.

a nervous habit, and this tends to brush foreign matter, such as dirt, dust, and the like into the pail during milking, particularly when the tail is filled with the filth of the yard or pasture. The invention prevents such milk contamination.

### Of General Interest.

A FILTERING APPARATUS.—DR. A. H. BALDWIN, Norwalk, Conn. The accompanying drawing shows a filter of very inexpensive construction and one that can be maintained at little cost. It is adapted to be located in the city instead of at the source of supply. It consists of an iron reservoir about twelve feet deep and filled with sand to about two feet from the top. Water is turned in at the bottom under city pressure and forces its way up through the sand until it overflows a standpipe. Thence it is led through several eight-foot tanks filled with animal charcoal, and



FILTERING APPARATUS.

passes through an aerator located above a second reservoir. When this reservoir is filled the supply to the filter is automatically turned off by a float. The filter does not need to be cleaned until about eight of the ten feet of sand has become vitiated from the bottom up. Experience has shown that most of the organic matter is oxidized in the sand, so that 10 per cent of the quantity that would accumulate on the surface of an ordinary filter is to be found in this filter. With this system only the water for drinking purposes is filtered. That which is used for watering the lawns, for instance, is not robbed of its fertilizing material. See advertisement on page 598 of this issue.

PRODUCTION OF WET CARBONIZED PEAT BRIQUETS.—N. TESTRUP, 6 Broad St. Place London, E.C., England, and T. RIGBY, Station Hotel, Dumfries, Scotland. The invention relates to the production of peat which has been heated to a temperature between 150 degrees and 250 deg. Cent. under pressure as proposed by Ekenberg. The process allows of effecting a material saving in the cost of producing briquets from such material relatively to the cost of production according to processes previously proposed therefor.

EDUCATIONAL CHART.—C. E. BIRCH, care of Haskell Institute, Lawrence, Kan. This invention relates to charts adapted for use in the teaching of arithmetic to children, and one of the main objects thereof is to provide a device of such form as to facilitate certain fundamental drills and to make them interesting and effective and, also, by making them competitive.

POLISHING MITT.—H. W. HEPNER, care of Muhlenberg College, Allentown, Pa. The invention provides an article with a tubular brush, affording a number of surfaces, adapted for special employment; provides a wallet-like container for said brush, foldable to facilitate personal carriage or the packing within a satchel or trunk; and provides a device having means for carrying a toilet equipment.

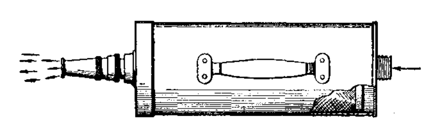
PARCEL POST PROTECTOR FOR MAIL SACKS.—HANNAH HAZELTON, 377 Quincy St., Brooklyn, N. Y. The invention has reference more particularly to a protector designed to fit in a mail sack in order to reinforce the latter for the purpose of preventing injury to articles placed in the sack during the handling and shipment, and more especially as applied to parcel post transmission.

FASTENER FOR BOX COVERS.—F. D. VAN VALKENBURGH, Delachise St., New Orleans, La. The present invention has reference to a novel fastener for box covers, and is designed more particularly for use in connection with shipping cases having reversible covers, and intended to be returned to the shipper. The invention is applicable to any improved form of case.

WATCH CASE AND MOVEMENT PROTECTOR.—E. A. RONEY, Goldfield, Nev. One of the principal objects of the invention is to provide a pouch or a shield formed of insulated material and adapted to receive a watch whereby to prevent the conduction of electrical current through the watch and to protect the watch from dust and dirt.

SANITARY SODA CUP.—D. F. CURTIN. Address The Vortex Mfg. Co., Goetz Bld'g., 412-420 Orleans St., Chicago, Ill. This invention provides a cup for use in dispensing beverages, as, for instance, in soda fountains and like places, wherein a holder is provided for permanent use and a particular form of cup for use with the holder, each cup being designed to be discarded after one using.

SPRAYER.—NELLIE M. MCCAULEY, Kalispell, Mont. The improvement refers to sprayers and more particularly to a device for spraying insecticides or other liquids. A spray is provided which utilizes the water pressure in



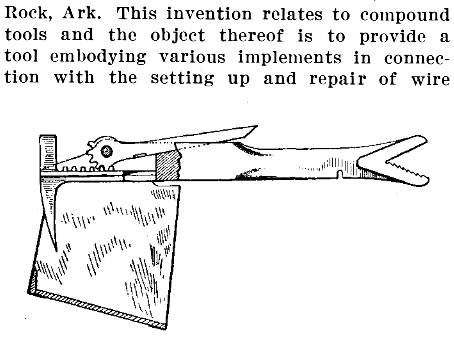
SPRAYER.

an ordinary garden hose or one of a similar nature, in spraying the liquid without resulting in the mixture of the water with the liquid. The accompanying engraving shows an elevated view of the sprayer partly in section.

### Hardware and Tools.

DOOR LATCH.—F. E. RICHARDSON, Manchester, Iowa. This invention relates to means for holding doors in closed position, particularly sliding doors such as are used on barns and the like. The latch is used as a lock for the door in conjunction with a wire yoke and a pad-lock, and may be operated from the outside or from the inside of the door in its normal use.

COMPOUND TOOL.—S. E. DENT, Little Rock, Ark. This invention relates to compound tools and the object thereof is to provide a tool embodying various implements in connection with the setting up and repair of wire



COMPOUND TOOL.

fences, the inventor's object in particular being to provide an implement of this character, including novel and improved means for withdrawing fence wire staples in such a manner as to permit of their subsequent use.

### Heating and Lighting.

KILN.—S. P. BEEROUT. Address W. B. Gray, 1327 S. 22nd St., Louisville, Ky. The inventor provides a kiln of the circular stationary type, for use in burning sewer pipes, tiles, conduits and other products from shale and clay, wherein a novel arrangement of flues, passages and supporting floors is provided, so arranged as to obtain a uniform heat effect on the ware, throughout the interior of the kiln, to insure uniform burning of the ware.

### Household Utilities.

FAN ATTACHMENT FOR ROCKING CHAIRS.—W. L. KLINE, Feronia Way, Rutherford, N. J. The invention provides a fan attachment for rocking chairs, cradles and similar articles of furniture, and is arranged to produce a continuous current of air directed onto the occupant as long as the rocking chair or similar article is rocked.

JAR COVER.—ISABELL BELL, 221 St. Anthony Ave., St. Paul, Minn. This invention relates to a temporary cover, attachable to jars and like vessels, such as butter and preserve jars, jelly glasses and the like, whereby to protect the contents of the jar from dust and flies. The cover has provision for adjusting its size to suit jars of varying diameter, within the capacity of the cover.

### Machines and Mechanical Devices.

STRAW HOLDER.—E. O'CONNOR, 2945 Cedar St., Everett, Wash. The particular object here is to provide a machine in which a supply of drinking straws may be held and mechanically dispensed one at a time in order to prevent contamination of many straws upon the removal of a single straw in the holders at present employed for this purpose.

TRIMMING MACHINE FOR ROLLS.—M. F. ANDERSON, care of Standard Oil Cloth Co., 320 Broadway, New York, N. Y. The inventor provides a new and improved machine for simultaneously trimming both ends of a roll of oil cloth or other material, and arranged to permit convenient adjustment of the knives or cutters for trimming rolls of different length.

### Prime Movers and Their Accessories.

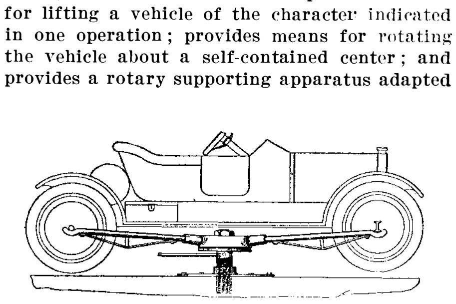
PACKING.—G. MCCADDEN, St. Cloud, Minn. In the present patent the inventor's object is the provision of a new and improved packing for use on pistons and other devices and arranged to prevent leakage of the motive agent past the packing from one end of the cylinder to the other end thereof.

### Pertaining to Recreation.

BILLIARD CUE TIP FASTENER.—L. CIARLELLI, 146 Bradford St., Bristol, R. I. In the present patent the invention has reference to a novel means for fastening the tip to cues, the object being the provision of means for the secure holding of the tip, while permitting of its ready removal and renewal whenever desired.

### Pertaining to Vehicles.

AUTOMOBILE JACK.—I. W. FURMAN, Bay Shore, N. Y. This invention provides means for lifting a vehicle of the character indicated in one operation; provides means for rotating the vehicle about a self-contained center; and provides a rotary supporting apparatus adapted



AUTOMOBILE JACK.

for removal from its service position. The engraving herewith gives a side view of the jack, and showing in conjunction therewith an automobile, the same being supported in lifted position thereon.

ASH CART.—H. MECKING, 1044 Hall Place, Bronx, New York, N. Y. The invention has reference more particularly to a cart arranged with a closed top, which top is provided with an ash-barrel inlet supplied with a hood, and means at the inlet to facilitate the discharge of the ashes from the barrel and to prevent the falling of the barrel into the cart.

VARIABLE SPEED GEARING FOR MOTOR CYCLES.—E. A. BLACK, Phœnix, B. C., Canada. The invention has special reference to motor cycles having but one speed and usually termed single speed machines, by which the operator has all the advantages of the high or usual gearing on level roads and of low gearing on hills or bad roads. The drive parts and controlling means obtain the high and low speeds or permit the engine to run free while the motor cycle is at a state of rest.

### Designs.

DESIGN FOR A PLATE OR SIMILAR ARTICLE.—LE ROY C. LEWIS, care of Koehler & Hinrichs Co., St. Paul, Minn. In this ornamental design the plate is of circular form and bearing on its outer edge a wreath within which are two animals sitting upright and clasping their fore paws.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

## NOW ON SALE

*The* 70th ANNIVERSARY NUMBER *of the*
**SCIENTIFIC AMERICAN**
**JUNE 5, 1915**

DURING a period of seventy years, since 1845, the Scientific American has faithfully chronicled the technical and industrial progress which we Americans have made. What an age of wonders it has been! What a transformation has been wrought upon the face of the earth! Surely no tale of the Arabian Nights, no fancy of Jules Verne depicts marvels so amazing as those which the Scientific American has been the first to describe authoritatively as soon as they appeared.

In the June 5th number the Editors have done full justice to the great theme of American inventions, producing a number which will transport us all back to the time when our fathers and grandfathers still burned candles, when horses still pulled street cars, when there were no automobiles, and when the steam railroad was a curiosity.

Every reader of the Scientific American, every American interested in the progress of invention, will want this number. Order now from your dealer or direct.

*FOR SALE ON ALL NEWS-STANDS—PRICE 25c*
**MUNN & COMPANY, Inc., Publishers, Woolworth Building, New York**

## A Study in Instinct

(*Concluded from page 596.*)

themselves to fall to the ground, where they wriggle into the soil and change to pupæ. In this state they pass the winter; and not until the following summer do the adult beetles emerge and creep up the birch stems. We perceive, therefore, that the weevils of any season, when first they appear, must be complete strangers to their environment, nor can they possibly have witnessed the rolling-up of leaves by individuals of the preceding generation. Thus, it is plain that imitation plays no part in the subsequent procedure of the insects. The whole elaborate process of cutting and rolling, conducted with so much precision and apparent skill, must be the outcome of pure instinct.

Most of the attempts that have been made to expound the nature of instinct are founded upon one or the other of two theories. The first, often called the "theory of lapsed intelligence," assumes that the actions that are now performed instinctively were originally due to intelligence, the latter faculty having since fallen into obsolescence. But this theory obviously demands that the habits acquired by the animals of one generation, by the exercise of their intelligence, should be handed down through succeeding generations. In other words, we are asked to assume that acquired characteristics are transmissable. The force of this criticism is crushing, since the great majority of biologists nowadays believe, on what appears to be ample and conclusive evidence, that such is not the case.

The second theory of instinct is more plausible. Its supporters urge that the basis of an instinctive action must be looked for in the simple reflexes that are inseparable from living protoplasm. All animals respond in definite ways to the stimuli which they encounter; and it is believed that the slight, individual variations in these responses are subject to natural selection. In a word, an instinctive action must probably be regarded as a co-ordinated series of reflex acts, the first reflex in the chain being evoked by the appropriate stimulus, and thereafter serving, in part at least, as the stimulus for the next. Moreover, instinctive actions, each a chain or reflexes, may themselves be linked up, as it were, to form an elaborate system of behavior such as is evinced by the leaf-rolling weevils referred to above. Obviously, a given instinct, if once established by natural selection, will be maintained in efficiency by the same agency, exactly as the colors or other physical properties of the organism are continually maintained at the level necessary to insure the perpetuity of the species. A *Rhynchites* weevil defective in instinct—to the extent, let us say, of being unable to project its curves accurately—would almost certainly fail to make adequate provision for the needs of its offspring, which would thus be doomed to perish in infancy.

## The Use of Poisonous Gases in Warfare

(*Concluded from page 595.*)

soaked with chemical solutions can be employed. The present writer has had some experience of working in chemical works in atmospheres containing chlorine and sulphurous acid gases, and has found that when the air is not too heavily saturated with these gases, considerable relief in breathing can be obtained by a "gag" of linen or flannel held tightly in the mouth. The air is drawn into the lungs through this "gag" and is exhaled by the nose without loosing the grip of the teeth on the "gag," and it is possible to stay in an atmosphere lightly charged with chlorine or sulphurous acid for some minutes, with the aid of this simple form of respirator.

In more heavily charged atmospheres, one requires a much thicker roll of flannel to be of any service, and the men engaged in the manufacture of bleaching powder (hypo-chlorite of lime) wear muzzles of damp flannel several inches in thickness, tied tightly over their mouths, in order to enable them to breathe and work in the

## LEGAL NOTICES



## Classified Advertisements

gas-charged chambers where this chemical is made. A form of respirator which is capable of holding cotton-wool or cotton-waste, soaked with chemicals, is shown in Fig. 3. This form, it will be noticed, covers the nose and has an exit-valve for the exhaled air. It is patented by R. Spasciani of Milan, Italy, and has been sold in England for some time. Fig. 1 shows another form of respirator capable of being used with absorbing chemicals. The metal cover in this case is made of aluminium.

In cases of gassing by chlorine, the inhalation of ammonia gas will be found to give great relief, since it combines with the gas that has entered the bronchial tubes and lungs, and removes the difficulty in breathing. The suggestion that ammonia might be used in front of the trenches for combining with and condensing the whole of the noxious gases used in these attacks by the Germans is, however, impracticable, since the gas is very volatile and quickly disperses, also if used in condensed form in front of the trenches its effects upon the human breathing system would be nearly as severe as those of the chlorine and sulphurous acid gas.

The only practicable method of meeting these gas attacks, apart from the use of respirators charged with absorbing chemicals, such as bicarbonate of soda and similar alkaline salts, would appear to be that of creating a counter air current, which would either roll the gases back, or would lift the clouds of poisonous vapor as it drifted clear over the trenches of the Allies. It might be possible with the aid of the army engineers to adapt the engines and propellers of aeroplanes for this work, or to arrange for gasoline operated air pumps to be stationed at certain points in the lines most subject to these gas attacks. These attacks, it must be noted, are only delivered when a light breeze from the north and northeast favors the German design. In a strong wind the gases would be dispersed and carried over the Allies lines of trenches too quickly to effect much harm. A slight counter air current ought to suffice, therefore, to deflect the direction of the gas cloud as it slowly drifts over the ground between the two lines of trenches, and even if only certain selected portions of the allied trenches could be kept free from the gases in this way, they would serve to act as a rendezvous for the men engaged in the defence.

These anti-gas fans and pumps of course would have to be well hidden and protected from German observation, otherwise they would soon be located and smashed by the enemies' fire. Placed in small "dug outs" at the rear of the first line trenches and connected with these by underground ducts or flexible hose-pipe, they should, however, prove of great service in repelling attacks of poisonous vapor.

### Preventing the Corrugation of Street Car Rails

TROUBLE has been experienced for many years in the corrugation of the main rails on street car roadbeds, particularly over long, straight stretches. The car wheels wear the rails unequally so that they become wavy and undulating on the surface. This results in continuous bumping of the car, and on account of the noise gives the well-known "roaring rail."

Many experiments have been carried out in the hope of preventing this unequal wearing of the rails, as such prevention would not only increase the speed and lessen the traffic noise, but would also save millions of dollars in renewal expense for rails, axles, and wheels. It is estimated that a modern city would save at least $50,000 a year if the corrugation could be prevented.

The most successful experiment so far has been to install differentials similar to those used in motorcars. The wheels when used with a differential wear down one eighth inch less in diameter over a distance of 1,500 miles. Such a change, it is hoped, will obviate a great deal of the noise and will let us come partly into our dream of noiseless locomotion and will advance us one step ahead of "our semi-civilized traffic."


# More Reasons for 1916 Hudson

To all the HUDSON attractions we now add these:

Yacht-Line Body
Ever-Lustre Finish
A Roomier Tonneau
More Luxury
A $1350 Price

That price means another $200 reduction, the second in twenty months. Both have resulted from multiplied output, due to the car's popularity. Now at $1350 we are swinging open in the widest way the gates to HUDSON class.

### *Some Other Things You've Wanted*

We do not, and we cannot, offer you a better chassis. Nobody wants or expects it. Howard E. Coffin did his best in designing this. Our engineering corps has done its best in refining it. This final Six embodies all that seems to us desirable.

In twenty months, 15,000 men have bought this new-type HUDSON. They've applied every possible test. And not one, we believe, has ever seen, or wants to see, a better car than this.

But there are things you do want, which all cars lacked, and we've brought them out this year.

### *Yacht-Line Body*

This is the fruition of all aims since foredoors were inserted. Then came straight lines, then streamlines, but all those lines were broken. In this Yacht-Line Body we reach perfection in graceful, sweeping lines. Even the door lines are unbroken. The body and door tops form a level line, and that line is *leather-bound.*

We have widened the rear seat so three big folks don't crowd it.

We have built a roomier tonneau. And the room is doubled when only five are riding. The two extra seats completely disappear.

We upholster with enameled leather this year, the costly finish of the high-priced car. Thus we bring you all the comfort, all the luxury possible to give.

For safety's sake, and for extra wear, all wheels have non-skid tires.

### *Finish That Stays New*

And now we bring out a much-wanted innovation—our Ever-Lustre finish, exclusive to HUDSON cars. It has required an immense factory addition, equipped with ovens to hold hundreds of bodies.

Now each under-coat of finish goes on under pressure, is forced into every pore. Then each is baked on to give it wondrous hardness. The result is a finish which keeps its newness and lustre. It resists weather and washing, rubbing and mud. It combats as never before the main cause of depreciation.

### *A Trebled Output*

But our best announcement is a trebled output. There will be overdemand for a while now, as with every new-model HUDSON. But the long waits of last year will not be repeated. And men who want HUDSONS will not be forced to take some second choice.

We are building of this new model 100 cars daily—a record fine-car output. You can get one—perhaps at once—if you see your dealer now. These new cars are now everywhere on show.

**7-Passenger Phaeton or 3-Passenger Roadster, $1350, f. o. b. Detroit**
**Also a new Cabriolet, $1650, f.o.b. Detroit**

Each HUDSON car brings with it the matchless HUDSON service. Ask our dealer to explain it. You will see how much it means.

HUDSON MOTOR CAR COMPANY, Detroit, Michigan

# SCIENTIFIC AMERICAN


ITALY ON A WAR FOOTING


Vol. CXII. No. 25
June 19, 1915

Munn & Co., Inc., Publishers
New York, N. Y.

Price 10 Cents
$3.00 A Year

SEVENTY-FIRST YEAR

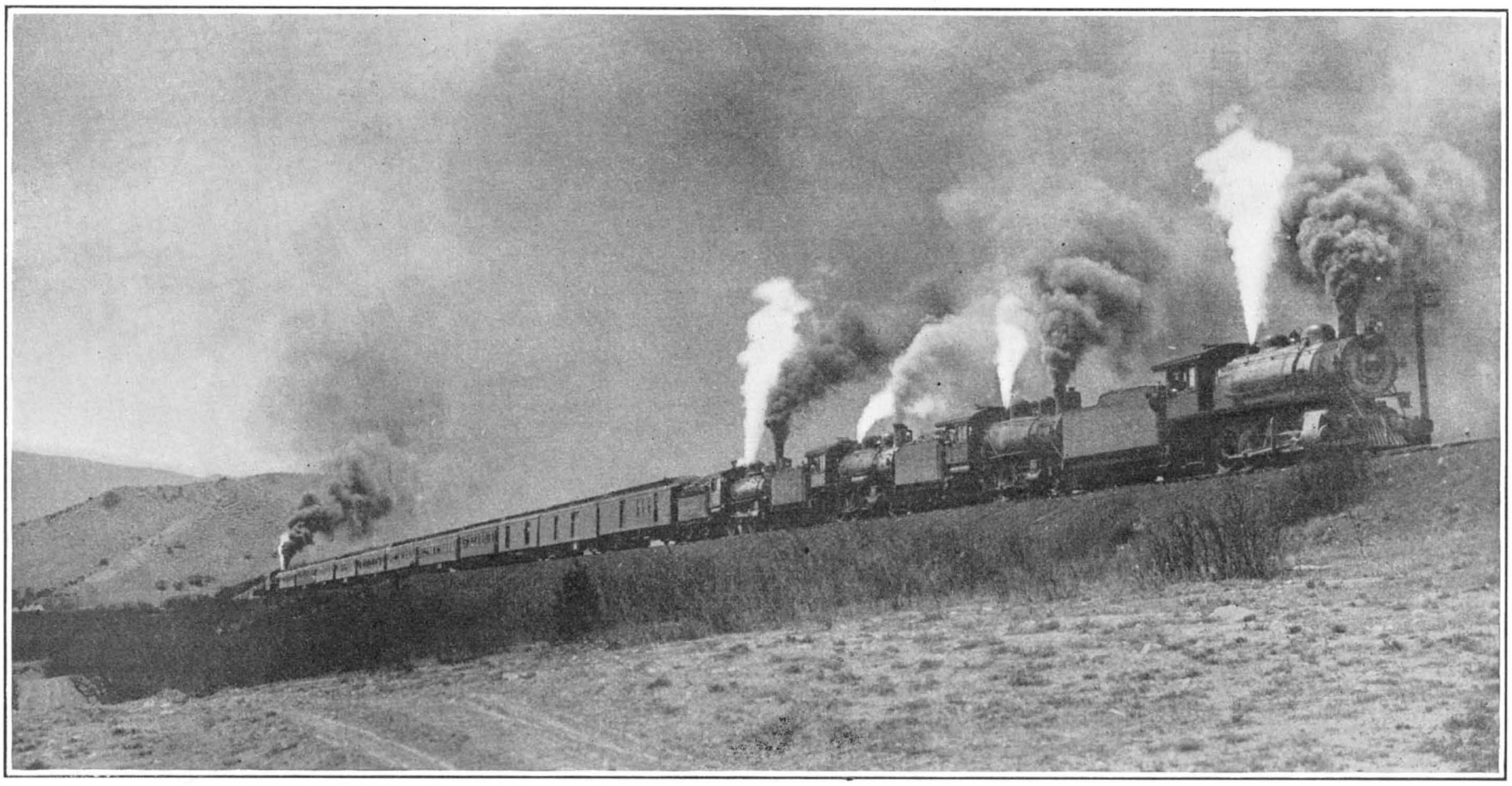
# SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

VOLUME CXII.
NUMBER 25.

NEW YORK, JUNE 19, 1915

10 CENTS A COPY
$3.00 A YEAR



**Eastbound train crossing the divide at Soldiers' Summit on the Denver and Rio Grande Railroad. Compare this picture with that below.**

## Running Railroads by Water Power

**By Thomas F. Logan**

THE accompanying photograph of a Denver & Rio Grande train gives an illuminating view of one of the results of water power conservation. Note that this train has eight passenger coaches, three baggage and express cars and five locomotives. Note the unconsumed fuel discharging from the stacks. Note the waste of fuel represented by the steam discharge from the safety valves.

Coal is used less efficiently in a steam locomotive than in any other type of modern prime mover, i. e., in a steam locomotive, it takes more coal to move a ton weight than in any other form of engine.

The combined power of the steam locomotives in the United States is in excess of 50,000,000 horse-power. Of course, all of these locomotives are not in action at the same time. It would probably be liberal to say that 30 per cent are at work at the same time. Assuming this to be correct, we have about 15,000,000 horse-power being developed by railroad locomotives each day in the year.

They consume either coal or oil—for the most part, coal. Our stores of coal are exhaustible. Every pound used makes the available supply so much less and our supply can never be replaced as coal. In the year 1913 we used in the United States 571,048,128 short tons of coal, of which 20 per cent was used by the railroads. This is about 114,200,000 tons of coal.

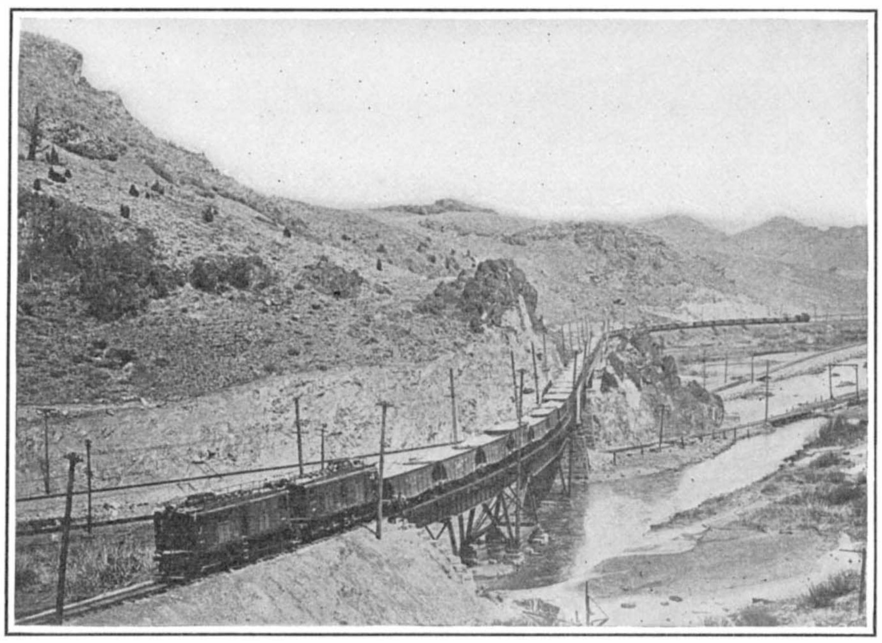
In contrast with the Denver & Rio Grande picture, note the second photograph. It is a train of seventy-five heavily loaded ore cars on the Butte, Anaconda & Pacific Railroad in Montana. The grade over which that train is going uphill is greater than that on the Denver & Rio Grande road, yet that seventy-five-car train is easily hauled by two electric locomotives, the power to operate which is supplied from hydro-electric plants. Were it not so supplied, that hydro-electric power would be going to waste, as it unfortunately is all over the country. This Butte, Anaconda & Pacific Railroad is, therefore, an agent of conservation. It uses up no coal as does the Denver & Rio Grande Railroad. There are plenty of water power sites along the Denver & Rio Grande Railroad that could be used for operating the trains, but they are all on Government land, and they cannot be developed under present laws.

Every pound of coal used in manufacturing must be supplemented by another pound of coal to transport the manufactured products. This is a striking and true statement and very conservative. Therefore, when we come to consider water power versus coal, the demand for water power is two-fold. According to the thirteenth census of the United States, the power used in manufacturing was 18,675,346 horse-power, the greater part of which was generated by the consumption of exhaustible fuel. If we use the extremely low coal consumption of 7½ tons per horse-power year, we have a coal consumption for manufacturing of 140,000,000 tons, and for the hauling of these products, 114,200,000 tons, giving us a total coal consumption of 254,200,000 tons necessary to the making and distribution of our manufactured products.

There is much complaint by the railroads concerning increased costs and decreased earnings and the problem is a vital one. The public naturally hesitates to approve a proposal to increase railroad rates. There has been much discussion concerning more economical operation of railroads. By its water power policy, the United States has, in effect, legislated against the economical operation of railroads. See what has happened in the case of the Butte, Anaconda & Pacific Railroad. Previous to electrification, that road paid an average of $22,500 per month for coal alone. That represents the free on board price. The railroad had then to sustain the additional expense of transporting that coal over its own line. Since electrification, this road has paid a little over $8,000 per month for delivered motive power. This means delivered at the locomotive. No extra expense has been incurred for hauling fuel. Therefore, this road has made a saving in operation of $174,000 per year. As the road is only 80 miles long, the saving amounts to $2,170 per mile per annum.

The Chicago, Milwaukee & St. Paul Railroad is now electrifying 450 miles of its road between Harlowtown, Montana, and Avery, Idaho. Its contract for power involves an annual payment of $550,000. Remember, this is delivered power. The present cost of coal over these 450 miles of line is $1,750,000 per year, and the railroad owns the mines. Nearly 35 per cent of the railroad equipment is used in carrying that coal to its coaling stations. But this expense is not included in the above $1,750,000. Considering only that figure, we have a prospective saving of $1,250,000 per annum, equivalent to $2,666 per mile per annum. All of this electric power, by the way, is generated at water power sites which are located on private lands. It has not been possible to prevent the development of these power sites under destructive laws and conservation policies. The story is different, how-

*(Concluded on page 616.)*



**Seventy-five heavily loaded cars on the Butte, Anaconda, and Pacific Railroad operated from a hydraulic-electric plant. No smoke, little waste power.**

# SCIENTIFIC AMERICAN

**Founded 1845**

**NEW YORK, SATURDAY, JUNE 19, 1915**

Published by Munn & Co., Incorporated. Charles Allen Munn, President; Frederick Converse Beach, Secretary; Orson D. Munn, Treasurer; all at 233 Broadway, New York.

Entered at the Post Office of New York, N. Y., as Second Class Matter
Entered as Second Class Matter at the Post Office Department, Canada.
Trade Mark Registered in the United States Patent Office


**Subscription Rates**

| | |
|---|---|
| Subscription one year | $3.00 |
| Postage prepaid in United States and possessions, Mexico, Cuba, and Panama. | |
| Subscriptions for Foreign Countries, one year, postage prepaid. | 4.50 |
| Subscriptions for Canada, one year, postage prepaid | 3.75 |

**The Scientific American Publications**

| | |
|---|---|
| Scientific American (established 1845) per year | $3.00 |
| Scientific American Supplement (established 1876) " " | 5.00 |
| American Homes and Gardens " " | 3.00 |

The combined subscription rates and rates to foreign countries including Canada, will be furnished upon application.
Remit by postal or express money order, bank draft or check.

**Munn & Co., Inc., 233 Broadway, New York**

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp* the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

*The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.*

## The Recent Change in the Cabinet

THE recent resignation of the Secretary of State has brought to a head a movement which it is now evident had been in course of development for many months. Although the break between the President and the Secretary of State was the direct issue of a conflict of policy with reference to the "Lusitania" outrage, it is evident that the breach had been widening owing to differences of opinion with reference to the policy of State. These differences are fundamental and irreconcilable. The people of this country believe in peace and look upon war with the same horror as the Secretary of State; but they do not believe in proclaiming that there is peace when there is no peace. It may safely be stated that the infraction of the rights of American citizens and the taking of their lives wantonly and without excuse will not be tolerated.

The late Secretary of State is a gentleman of much sweetness of temper and gentleness of nature, but events have shown that he was entirely unqualified for the serious responsibilities of his important position. This was chiefly due, it seems to us, to an utter lack of appreciation of the greatness of this country and of its vast humanitarian and commercial responsibilities. It has been well known that during the two years of his office American merchants owning property in Mexico or South America, or having commercial relations with those countries, have received but scant consideration in the Department of State. After interviews with the Secretary of State they have frequently come away from the Department with the feeling that, in addition to the lack of Government protection, they were suffering personal disfavor because of the mere fact of their having established business enterprises in foreign countries. It is a notorious fact, and one which has brought the blush to the face of many Americans, that although during the strife which has occurred in our neighboring republic, American citizens have lost their lives and been subjected to outrage, the Department of State apparently did not regard these acts with the horror that their seriousness demanded. This country's future demands a different policy from the rural dispensation of the past two years. It has vast foreign interests, and its commercial relations abroad are of an intricate and extensive character. These interests must not be jeopardized by any weakness of policy of the State Department. The United States must discourage the belief that American lives can be sacrificed with impunity.

That this policy of "no protection" has been brought to an end is very evident from the recent message which has been sent to the Mexican chieftains and from the message to Germany protesting against the infraction of American rights.

The European war now has been in progress for nearly a year, and at the very outset, the people of our land were rudely awakened to the fact that certain forces were in action which were strange and new to them; that human nature had not reached the ideal state which the American people had supposed; that in spite of living remote from European strife and in supposed safety from European entanglements, we were likely to be dragged into complications which we could not foresee. Efforts were made, therefore, to induce Congress to take some action—not to establish a large standing army or a great navy, but to strengthen both arms of the service so that the country could be placed in a condition at least of adequate defense. Such influences as were brought to bear, however, came to naught, and Congress adjourned without making any provision to improve the condition of the Army and its reserves. Indeed, it did so little to remedy the avowed and well-known deficiencies in the Navy, that an almost unprecedented condition of affairs has followed, in which private citizens have formed themselves into associations and bodies of men, independent of the Government, to try to remedy the failure of the Government to provide for its military deficiencies. A number of influential associations have been formed whose policy is not only to educate the people in the facts regarding our military weakness (so well known abroad and in professional circles here), but also to organize young men voluntarily into groups and bodies of men, for military training. All this has been done without support or even recognition from the Government.

It was surmised before the war broke out, and has been proved during the ten months of conflict, that naval warfare has been greatly modified by the advent of the submarine. It became known that our own submarines were defective, that they were not sufficient in number, and that only a few were in a condition for actual service. Through some defect in one of these craft a number of our brave sailors lost their lives during simple peace duty. What sufficient action has our Navy Department taken to remedy this well-recognized deficiency in this arm of the service? The recent Congress ordered the construction of several new submarines, but made no provision for the officers to man them. No provision has been made for building any battle-cruisers—an invaluable type of ship—as the war has proved.

The one thing that the SCIENTIFIC AMERICAN would deplore above everything else would be that we should become entangled in the European or any other war. This would be against the spirit of our people and certainly against their interests. The lesson we have tried to teach through the columns of the SCIENTIFIC AMERICAN has been that of preparedness for defense and the protection of its citizens against injury and insult.

## Ammunition and Finance in the Present War

A FEW months after the opening of the European war a leading general of the German army stated that the expenditure of ammunition had proved to be more than double the amount which the staff had estimated. And that statement was made before it had been demonstrated, as it has been lately on the western battle front, that the only possible way to break the apparent stalemate produced by trench warfare was to plow up the enemy's trenches by a concentration of high-explosive shell fire, the like of which had never been seen, and was certainly never contemplated in modern warfare. Nevertheless, in spite of an expenditure of ammunition which to-day must be between two and three times as great as was estimated before the war by the Germans themselves, and in spite of the enormous battle front on which the Teutonic Allies are engaged, there are no indications that they are suffering from a scarcity of ammunition. This is to be explained by the fact that, for many years, the central powers have been laying up a huge reserve of ammunition for a conflict, the date and the extent of which had probably been determined and certainly had been lavishly provided for. Add to this the probability that, from the very commencement of the war, all the manufacturing plants which were capable of turning out ammunition were reorganized, re-equipped and set to work at their maximum capacity, and the manifest superiority of the Teutonic Allies in the matter of ammunition supply is readily understood.

It becomes increasingly evident, as the war goes on, that the question of victory or defeat for either side will be determined on the German western battle front; and here, if, as the Allies hope and believe, they are to drive the German line back upon the Rhine, the thing can be done only by blasting them out of their trenches, line beyond line, by a concentration of explosive shell and shrapnel fire so great, that even the German resources will be outmatched, not in one particular engagement or series of engagements, but day by day, week by week, and month by month, until the thing is done.

The tactics employed in this kind of warfare are fairly familiar to the general public from the published press reports. The batteries of the attack are masked along the given stretch of front to be attacked and the enemy trenches are subjected to a continuous rain of high-explosive percussion shells, which literally plow the trenches out of existence, breaking down the parapets, filling up the trenches with *débris*, and exposing the troops to a decimating fire. When the wreckage is complete, the high-explosive shell fire gives way to a rain of shrapnel, delivered back of the wrecked trenches in such volume that it is impossible for reserves to advance through the hail of bullets in sufficient strength to deliver a strong counter attack. Under the protection of this shrapnel fire, the attacking forces move forward and capture the plowed-up trenches, digging themselves in and consolidating the newly-won position. This form of warfare necessitates, above all, an enormous supply of ammunition, and an output from the factories that shall be on such a scale as to enable the generals in the field to carry on the offensive without any anxiety as to their ammunition supply.

Now, ammunition, especially of the high explosive and shrapnel shell type, is enormously expensive, and the drain upon the financial resources of the belligerents, if such a continuous attack is made and met, will be far in excess of anything that has occurred hitherto during the war. The question of ammunition supply becomes intimately associated with the question of financial resources.

In the unhappy event of our becoming embroiled with Germany, the United States, because of the enormous extent of its manufacturing resources and its vast wealth, would become the pivotal point around which the ultimate destinies of the war would turn. Without touching a soldier or a ship, or firing a gun, the enrollment of the United States on the side of the Allies would make their ultimate triumph absolutely secure.

## Up-to-Date Disinfection

THE newer disinfection—the destruction of disease germs in the homes of sufferers—has come about through knowledge gained the last half century as to how such infections as yellow fever, typhoid, malaria, measles, tuberculosis and the like are transmitted to mankind. As everybody now knows, yellow fever is transmitted only by *Stegomyia*, malaria only by *anopheles;* the body louse transmits typhus; such diseases are not "caught" by fomites (goods and fabrics that may happen to contain the germs), as was formerly supposed. Cholera and typhoid fever are not contracted through miasms; but solely by swallowing the essential germs of those diseases in food and drink thus contaminated. Diphtheria is probably not communicable through the air; but by direct contact with the sick, as in kissing; or by contact of one's nasal passages or throat with the diphtheria germs as contained in the handkerchiefs, dishes and the like used by patients. The safest place in the world as to diphtheria is the properly conducted, well-aired ward of a diphtheria hospital. Hospital doctors, nurses, and others, careful in their ablutions, are in constant attendance the year round on diphtheria, scarlet fever and measle patients, without contracting those diseases or being in any fear of them. The surest place not to contract consumption is a well-managed tuberculosis sanatorium.

Nor are scarlet fever and measles transmitted through the "peeling" or the skin eruptions in those disease. And measles is infectious anyway only during the first several days of the disease, generally before it is recognized, and from the germ-laden discharges from the noses and throats of sufferers.

Facts of this kind have led to more rational public health measures. Certainly disinfection destroys germs or renders them innocuous; but most germs cannot in any event retain their vitality and their capacity for mischief for any length of time after leaving the patient's body. And, as a matter of fact, the best disinfectants ever invented are pure air and sunshine. A sick room well ventilated after the termination of a case; the bedding, carpets, rugs, and so on exposed to the blessed sunshine; plenty of soap and water for scrubbing up. These factors will, for most infectious diseases, be all the disinfection necessary.

Thus, in accordance with the modern conception of infection spread, the Metropolitan Board of Health, in 1913 abandoned fumigation (disinfection by gases generated from sulphur, formaldehyde and the like) after diphtheria cases; but removed the bedding to its disinfection plant. Fumigation of the apartment was done only when the patient died or was removed to a hospital during the height of the disease, it being considered possible that in such cases fresh discharges containing living germs might be present in the sick room. Measles was similarly handled, except that the household goods were not removed for disinfection after death or recovery. In scarlet fever disinfection was done after recovery, death or removal; and the infected bedding was disinfected. In June, 1914, however, the department discontinued disinfection, by reason of the practical absence of danger from patient's effects, after cases of diphtheria, scarlet fever, measles, cerebrospinal meningitis and poliemyelitis. And with the beginning of the present year it was determined to discontinue fumigation altogether in all the boroughs of the Greater New York, except Brooklyn; and this in order for comparisons to be made and for a demonstration that discontinuance of the practice of fumigation will work no harm of any kind.

## Science

**The Crocker Land Expedition.**—The work of this Arctic expedition is to terminate with the present season. The schooner "George B. Cluett," a vessel used by the Grenfell Association in provisioning the mission stations along the Labrador coast, has been chartered to bring the explorers home, and will leave Battle Harbor for that purpose early in July. It is supposed that the expedition, which found Crocker Land to be non-existent, has been recently engaged in exploring and mapping the interior of Greenland.

**The Importation of Foreign Birds.**—According to a recent paper by Dr. T. S. Palmer, the Department of Agriculture issues about 500 permits annually for the importation of birds; the number of birds imported amounts to about half a million, and as many as 17,000 birds arrive in a single day. These include especially canaries, parrots, and game birds, but the total number of species imported is about 1,500. The department exercises great vigilance to prevent the importation of bird diseases, such as the "quail disease."

**Thunder at Sea.**—Baron von Humboldt was responsible for the statement that thunder is never heard on the high seas—i. e., at any great distance from land—though violent thunderstorms are often observed at sea and vessels are frequently struck by lightning. Is the statement true? Or, if thunder is sometimes heard, is its sound comparatively faint? These questions have provoked discussions from time to time at meetings of the Astronomical Society of France, and have recently been taken up anew by that society. It is suggested that the other noises prevailing on shipboard during a storm may be the reason why the thunder often passes unnoticed, but information on this subject from sailors will be welcomed by the French astronomers.

**Cures for Ivy Poisoning.**—*The American Botanist* publishes a letter from a Brookline, Mass., correspondent stating that fishermen along parts of the Massachusetts coast find a prompt cure for the effects of poison ivy and poison sumach in the fireweed (Erechtites hieracifolia). The poisoned parts are rubbed with the leaves of this plant, which must be fresh each time, bruised and crushed so that the sap moistens the skin freely. An editorial note mentions the fact that a large number of other plants have been recommended for ivy poisoning—notably touch-me-not and burdock—but that "it seems doubtful whether any of these herbs can do more than take the attention of the patient from his troubles and cure him by mental suggestion."

**The Loss of the "Endeavour."**—A note in the *Geographical Journal* records the probable loss of the fishery investigation vessel "Endeavour," belonging to the government of Australia, together with Mr. H. C. Dannivig, director of fisheries to the commonwealth government, his staff, and presumably some meteorologists and wireless operators from Macquarie Island. The vessel had proceeded to this island in order to relieve the staff of the meteorological station, which was established by Mawson's Antarctic expedition and subsequently taken over by the Australian government. She left Macquarie December 3d on her return voyage, and has not since been heard of, in spite of a thorough search for her by government steamers. The "Endeavour" was built in 1908 for fishery research in the open ocean on the lines of the Michael Sars, and had done considerable valuable work of this character.

**The Singular of "Sastrugi."**—No one can read any considerable amount of current literature relating to polar exploration without metaphorically stubbing his toe over one of those rugged ridges of snow which are known collectively as "sastrugi." This exotic term has become fully naturalized in the English scientific vocabulary, yet strange to say it is rarely met with except in the plural, and when an author undertakes to singularize it the result is apt to be singular in more senses than one. Thus Capt. Scott in his diaries mentions a "sastrugus," and this ostensibly Latin word is defined in the glossary appended to "Scott's Last Expedition." The dictionaries are much at sea on the subject. The new Standard, for instance, gives two forms of the singular, "sastruga" and "zastruga," and does not mention the plural at all, though, as we have stated, the plural "sastrugi" is the form commonly met with in English. The history of this word is traced by C. F. Talman in a recent number of the *Monthly Weather Review*. The word is Russian, and the original form is "zastruga," which means literally a rough splinter or shaving due to planing wood against the grain, but has also a number of derived meanings. The more or less permanent snow-ridges characteristic of the northern Siberian plains, where they show the direction of the prevailing winds and hence indicate to travelers the points of the compass, are called "zastrugi," and this word, altered to "sastrugi" in accordance with German rules of transliterating Russian, was made familiar to the world at large through the writings of Baron von Wrangel. It occurs in English as early as 1840. Given this form of the plural, consistency requires us to make the singular "sastruga," though the Russian is "zastruga."

## Aeronautics

**The Navy Gets More Hydroplanes.**—Two new hydroplanes were recently delivered to the Navy Department, three others are now under construction, and three further machines are to be contracted for this summer.

**Lazy Tongs Rim for Parachute.**—In a patent No. 1,138,140 Anton Oister of Unter Siska near Lailbach Austria-Hungary, shows a parachute whose rim is formed by a lazy tongs with springs at the joints of the tongs for automatically expanding the same and the rim of the parachute when the latter is released from a container adapted to hold it when in a collapsed condition.

**Noted Aviator Killed.**—A report has been received that Albert Moreau, the noted French aviator had been killed by his machine falling near Melum. Moreau has been very prominent in aeronautical matters for some years, and was the inventor of a safety device, with which he won a prize in 1913 by flying his self-righting aeroplane without touching the control levers.

**Aeroplanes to Locate Seals.**—The past sealing season in the Gulf of St. Lawrence, which closed May 1, was a failure owing to the difficulty of finding and reaching the herds in the unusually heavy ice, and entailed a loss of about $250,000 upon the owners of vessels. Next year it is proposed to engage two aviators to visit the east coast and the Gulf of St. Lawrence, respectively, just before the opening of the season and locate the herds. If successful, this plan will save the large amount of time now lost by sealers in searching for their prey, and should add correspondingly to the profits.

**A Dirigible for the Navy.**—It is announced that the Navy Department has ordered a dirigible aircraft from a Connecticut company, which is to be delivered within four months, and will cost $45,636. This craft will be 175 feet long, 55 feet in height and will accommodate eight men. The speed will be 25 miles an hour. This craft cannot be seriously regarded as a fighting machine, but is probably intended merely for practice purposes and for training operators for possible future craft. The battle cruiser North Carolina, which has become superannuated, is to be remodeled to serve as an aviation ship, and will be sent to Pensacola, which is to be made a station and school for training aviators. As soon as it is finished the new airship will be sent to the same place and a floating hangar is to be provided to shelter it.

**A New German Biplane.**—Just before the hostilities the Otto Company, of Munich, which had been building machines of the engine-behind type, brought out a new tractor, which is believed to be now in use by the army. It generally follows standard lines, with a rectangular body, topped with a turtle back. The upper plane has a slight overhang, and both planes have a decided taper toward the tips, the leading edges sloping backward. The lower planes are attached to the body, and the upper to a center section carried on a steel tube structure. Two pairs of steel struts connect the upper and lower wings on each side. The tail planes consist of a semi-circular stabilizing plane, to which is hinged the divided elevator, and of a partly balanced rudder, hinged to the stern-post of the body. The engine is a 150 horse-power Rapp.

**Big Foreign Orders.**—Many rumors of big orders from foreign governments for aeroplanes and motors are circulating through the daily press, the value of the material contracted for being estimated at $16,000,000. The latest report is that two orders, each for 1,000 aeroplane engines, are going a-begging because every manufacturer already has more orders for complete machines than he can handle. Speaking of these orders it is said that machines of the pusher type are preferred abroad, but our builders are not prepared to turn out this kind, having had no experience with them; however, it was a question of taking what they could get, so the foreign orders were placed for the tractor models that prevail in this country. There is apparently difficulty in procuring engines of sufficiently great power, as the foreign buyers demand motors of from 130 to 160 horse-power, and these are not being produced in any considerable numbers as yet.

**A Fund for Aero Defense.**—In view of the extremely backward condition of aeronautics in the United States, both in number of machines and qualified operators, the Aero Club of America proposes a national subscription, similar to those organized in France and Germany in 1912-1913 with a view to training aviators, procuring aeroplanes for the National Guard, Naval Militia and the Post Office Department, and to do whatever else appears necessary and possible to create an efficient aeronautical reserve, which at this time would seem most urgent. It is pointed out that not only have we practically no aeroplanes, but that out of the 150 licensed aviators in the United States, probably not over half a dozen have made flights of over 50 miles across country, and none have any knowledge of military requirements. The National Competition, commencing in July, which has already been noted, is hoped to stimulate interest and assist this movement. Contributions to the fund can be sent to the Aero Club of America, 297 Madison Avenue, New York.

## Inventions

**Another Dedicated Patent.**—Robert M. Chapin of Washington, D. C., has dedicated to the public patent No. 1,137,844 for a process of preparing a concentrated animal dip from arsenious oxide especially designed for dipping or spraying of cattle or other animals with a view to ridding them of Texas fever ticks or other deleterious parasitic insects.

**A Two-faced Doll.**—Practically two dolls in one is supplied by patent No. 1,138,412 to Mary E. Radick of White Plains, New York, who makes the doll head with two diametrically opposite faces, the expressions of the faces being different and the hair being so connected with the head that it can be moved to cover either face and expose the other.

**Foldable Sewing Machine.**—Sarah E. Avery of Columbia, S. C., has secured patent No. 1,136,921, which discloses a cabinet with a compartment into which the needle operating mechanism may be folded, also a folding table to support such mechanism for use and a drive mechanism which in use may underlie the table and when not in use will be housed between the folding table and the cabinet.

**Locking the Milk Bottle to the Door.**—Louis Levitt and Isidor Rendelman of New York city, provide in a patent No. 1,139,780 means for closing and clasping a milk bottle neck and a chain connected with the clasp and engaging under a door so that when the bottle is once secured it cannot be released until the door is opened. Something like this is needed when the milkman is ordered to leave milk at the door.

**The Only Universal Standardization.**—C. Francis Jenkins whose inventive activities in moving picture matters as well as in many other important fields of invention are well known, in a recent address in Washington city stated that the motion picture ribbon is the only unit that is standard in every country and that while railway gages for example vary in different countries, and units of value, volume, length and weight differ, the motion picture film is the same the world over.

**A Gaisman Safety Razor Improvement.**—Henry J. Gaisman of New York city, who sprung into prominence some months ago as the inventor of the autographic kodak, bought by the Eastman Company for a large price, in a patent, No. 1,139,115, presents a safety razor in which the flat blade which can be flexed in curved condition is used with a guard for its edge separate from the holder, with the blade and guard relatively adjustable, with means for holding the guard in graduated positions for purposes of shaving.

**Moth Proof Bags.**—In the spring season the packing of woolen garments demands attention. Moth proof bags are a convenience and the expense of the bags if used once and discarded suggests the possibility of devising a bag whose open end can be securely sealed by pasting in such a manner that when once cut open provision will be made for its repasting succeeding seasons. Incidentally the bag should embody means for suspending the garment within it, and for hanging the bag and contents from a supporting hook.

**Speaking Moving Picture Improvement.**—In patent No. 1,137,060 Orlando E. Kellum of Los Angeles, Calif., connects the moving picture camera and the sound recorder by wires so they operate synchronously and places the telephone transmitter on the person of the actor, electric connections being provided between the transmitter and recorder and suitable contacts being provided, including stationary contacts and contacts on the person of the actor and adapted to engage the stationary ones when the actor is in the field of view of the camera.

**Edison Colored Moving Pictures.**—Thomas A. Edison in a patent No. 1,138,360 presents a method of producing the illusion of scenes in colors in moving pictures. An image of all the elements of a scene of one fundamental color in that color is momentarily projected on the screen and thereafter successively projecting images which are superposed upon or registered with the first image on the retina of the beholder of those elements of the scene of different fundamental colors in their proper colors respectively. The successive projections are at such a rate that in accordance with persistence of vision, the preceding images will still be seen by the beholder until after the last image of the series has been projected upon the screen.

**Developing Effect of a Patent System.**—An American born son of an intelligent foreigner recently commented on the decadence of his father's native land and attributed its failure to progress and take a prominent part in the world's affairs to its lack of a patent system. He asserted, and correctly, that, no nation in recent time has made any substantial progress that did not foster invention by a reasonable patent system which would encourage invention and so develop the country's resources along lines of mechanical progress. If invention develops a nation, it likewise develops the individual, benefiting him not only indirectly by the pecuniary results but directly in the personal broadening resulting from his inventive effort.

Loading mine cases to destroy a derelict.

Placing mine to blow up masts of wrecked steamer "Monroe."

Blowing up a derelict with gun-cotton mines.

# Hunting for Derelict Ships

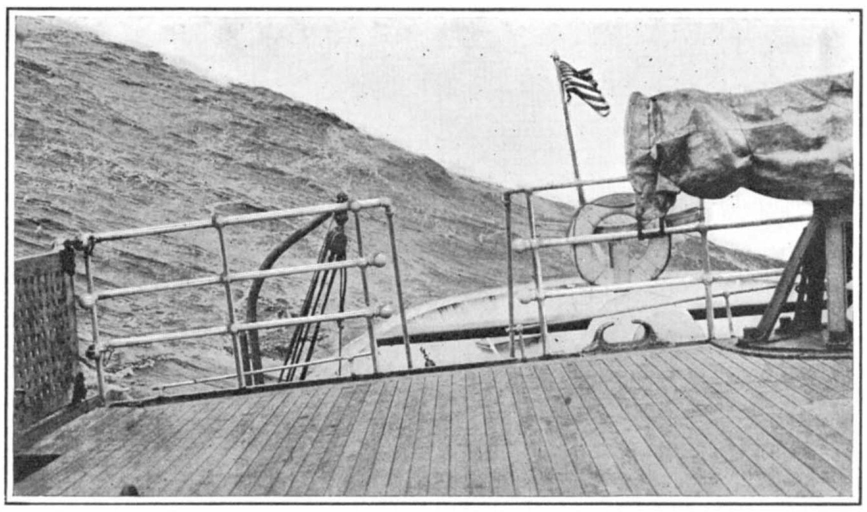
## The Difficult Work of Clearing the Seas

OF the numerous duties allotted to the United States Coast Guard cutters, one of the most interesting is that connected with the search for the derelict vessels left in the path of commerce by the periodic gales which sweep over the western ocean, and the salvage or destruction of these dangerous wanderers of the sea. The great majority of abandoned and drifting hulks come from the fleet of lumber-laden sailing ships plying our coastal waters or voyaging from southern ports to continental Europe. These craft, stripped of spars and sails by storms, or waterlogged and unmanageable from leaking sides, float with decks awash, often bottom up, prevented from sinking by their cargoes, and usually surrounded by attached floating wreckage which renders their approach in small boats difficult, and the placing of a working party on board extremely hazardous except under the most favorable conditions of wind and sea.

Dots upon the ocean, their dimensions shrink to invisibility upon the ocean charts by which the searching cutter tracks them; drifted from their reported positions by unrecorded winds and currents, low in the water and hidden by the passing waves, they enter the class of elusive objects not far behind the submarine boat of modern warfare. However, there is a well-organized campaign conducted against them, shared by all mariners and actively furthered by our Government. Here, as in so many other fields of maritime operation, radiotelegraphy plays an important part, and without it the chances of success in finding an object at sea are reduced to a minimum. Each of the hundreds of merchant steamers crossing and recrossing the ocean is a self-constituted observer and lookout for the discovery of these menaces to safety, and their positions when sighted are quickly and accurately flashed to the coastal stations, thus eliminating from the problem half of that destructive element, time, which formerly claimed its full allowance in delaying the start on the search, and by so much making it difficult or fruitless.

There are several approved methods of laying out the courses of the searching vessel once the vicinity of the reported position of the abandoned craft is reached. Allowance for its probable drift is computed for the time elapsed since the report of its position was sent out, and upon the correct results of this computation success or failure of the search largely depends. Human ingenuity must ever be on the alert in its predictions regarding those ever-changeable elements, the winds and ocean currents, and their varying effects upon each other from day to day. The drift of a waterlogged vessel off our Atlantic coast may reach as high as seventy or eighty miles in a day of twenty-four hours, and it is within the range from this figure down to zero that the computations must be made. When it is considered that with the most prompt action a delay of two or three days may ensue before the vessel sent out on the search can reach the reputed locality and that she then must take up a system of devious courses while her quarry drifts merrily on in a more or less direct course, some idea of the nature of the task can be formed.

When the reported position is reached the cutter may be set to describing upon the ocean waste one of several accepted geometrical figures. These comprise some form of spiral, or related parallelograms or triangles. Adjacent lines are maintained a distance apart not exceeding twice the estimated distance of visibility of the object sought, and this naturally varies from time to time with the condition of the atmosphere. The men in charge must decide, under penalty of increasing the steaming distance unnecessarily if their assumption is too small, or of missing the object finally if too great. For if it once be passed, the rule of search is such that there is little likelihood of the steamer's returning to the vicinity.

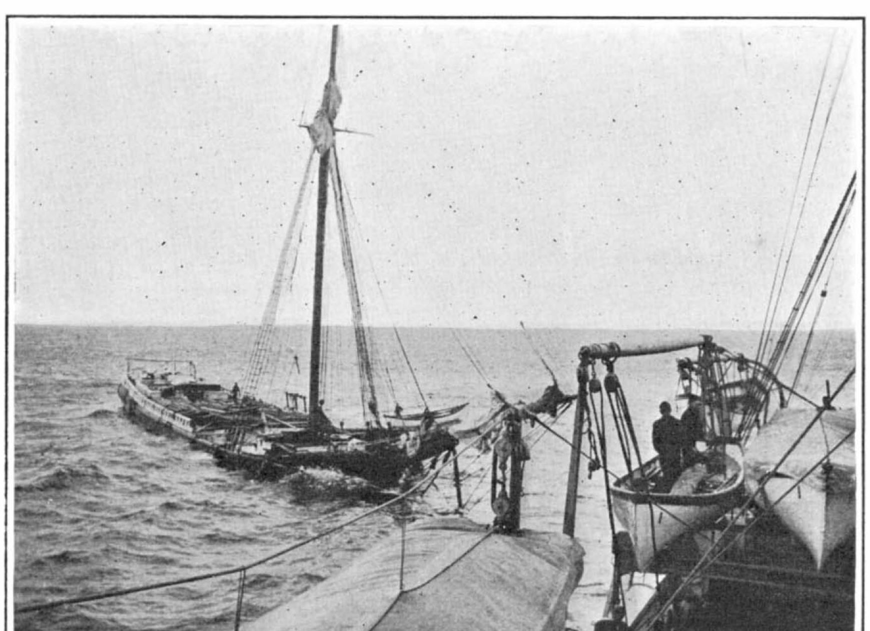


**Revenue cutter "Miami" running before a gale on April 14th, 1914.**

Note high sea on starboard quarter.

The search must necessarily be suspended at nightfall, but the steamer is kept as nearly as may be in the same position during the night, or if forced to steam ahead by heavy sea conditions, she is returned at daylight to the point where the search left off. Current set at this stage of the operations is not so important, inasmuch as it is likely that the steamer and the vessel sought for are under similar influences of drift. Granting that all the conditions have been correctly predicted and allowances rightly made, there comes the welcome moment when some sharp-eyed observer on deck or at the masthead announces the sighting of the wanderer. A distinct change in the mental atmosphere on board the steamer is at once apparent, as the methodical operations of a perhaps long and weary search give way to the active preparations for dealing with the stranger. If there is any possibility of towing the outlaw into port, the first effort will be made in that direction. This plan has the added value of saving property, which is, of course, the first thought of an organization created for the purpose. But the average derelict does not lend itself readily to the restraint of a towline, nor does it follow with good will in the wake of the towing steamer, but drags along now on one quarter, now on the other, occasionally coming up as far as abeam in a startling exhibition of perversity. For this reason, if the distance to land be great, the decision may be made to destroy the unwelcome intruder, and this is now generally done by the use of a standard guncotton wrecking mine.

Destroying a waterlogged hulk is, however, not always an easy operation. If the cargo is general merchandise or coal a single charge of explosive would quickly send it to the bottom; but when the hull is tightly packed with lumber, which is itself buoyant, no ordinary hole in the vessel's hull will have any effect, and it may be necessary to blow the hull into pieces, using many heavy mines, in order to disintegrate and disperse this troublesome cargo. Then again, a craft may have gone down in some comparatively shallow passage with her masts standing, and possibly not showing above the surface. In this case it often requires considerable labor and ingenuity to blow out these obstructions and make navigation safe. In one of the illustrations a diver will be seen engaged in work of this kind.



**Derelict schooner "Warren Adams" of Philadelphia.**

Cargo Southern Pine. Found by cutter "Itasca" and towed into Newport News.

### Cheap Substitute for Horn

A CHEAP substitute for horn can be made from wheat flour and sodium silicate. This substitute is very hard and strong, and, by inserting organic dyes into the composition while mixing, it can be colored to imitate almost any kind of horn substance.

The compound is made by mixing ten parts by volume of sodium silicate (40 deg. Baumé) with distilled water, and then stirring the resultant liquid into a thick paste with fine white wheat flour. The mass is then allowed to stand for three weeks, during which time it undergoes a chemical reaction that produces a hard hornlike substance.

This composition can be molded without pressure when first made, and turned and machined like brass after it has set.

# Photographing Speech

## Some Recent Investigations by Dr. Marage

By Jacques Boyer

DR. MARAGE is going to make the old adage "Words fly" untrue. Thanks to his fortunate discovery, words will not fly away of themselves any more; he has just succeeded in photographing the vibrations that compose them.

For overcoming the difficulty he directed his attention to the Pollak-Virag telegraphic apparatus, which he modified very skillfully, and to understand its functions we must first study the present work of Dr. Marage.

The Pollak-Virag telegraph (Fig. 1) is the most rapid of the known systems, for it can transmit 40,000 to 50,000 words per hour, while the Baudot sends 4,000 and the Morse only 400 in the same time. Before sending the signs which compose the dispatch a preliminary manipulation is necessary. By means of a special machine for writing (Fig. 3) holes are made in a narrow strip of paper, the different perforations of which correspond to the different letters of the alphabet. On the transmitting key the perforated paper unrolls and, according to the dimension and position of the perforations, a mechanism allows the passage of currents more or less prolonged at longer or shorter intervals. At the other end of the line there is a registering apparatus (Fig. 2), consisting of a mirror upon which a ray of light falls. Under the influence of the current sent by the transmitter the mirror is displaced by a horizontal-vertical movement and the beam of light makes an impression of various sorts on a sensitized paper which unrolls.

In order to avoid the secondary photographic operation the paper which has received the impression passes in unrolling into a first developing bath, then into a fixing solution. It is only necessary to read the message, as easy to decipher as a printed page, as the *facsimile* given shows.

Now that we know the principle of the Pollak-Virag telegraph, let us study some details of each of its parts.

The perforating machine, completely independent of the telegraphic system, makes in the strip of paper, which is moved by a guiding device operated by an electromagnet, holes of unequal size, whose series correspond to the text of the telegram. A letter in ordinary hand-writing includes really vertical and horizontal lines. Let us analyze, for example, the most simple letter of the alphabet, *l*. It is composed of a long vertical line, of a short vertical line which makes the curve, of a horizontal line joining them at the top, and a horizontal line at the bottom. In perforating the letter *l* will be represented by a large and a small hole, which will throw a strong current, then a weak one, into a telephone tracing vertical lines, and then by two small holes which will send two weak currents into the telephone inscribing the horizontal lines. In view of the succession and overlapping of the current one upon the other, the angles are rounded off.

To each letter of the alphabet correspond definitely 2, 3, 4—up to 10 different sized holes. Once the band is perforated the telegrapher inserts it into the transmitting apparatus. There an ordinary electric installation puts in motion the guiding device, while by means of the connecting plug (*la poignée d'un interrupteur*) the telegrapher puts the receiving station into the cir-

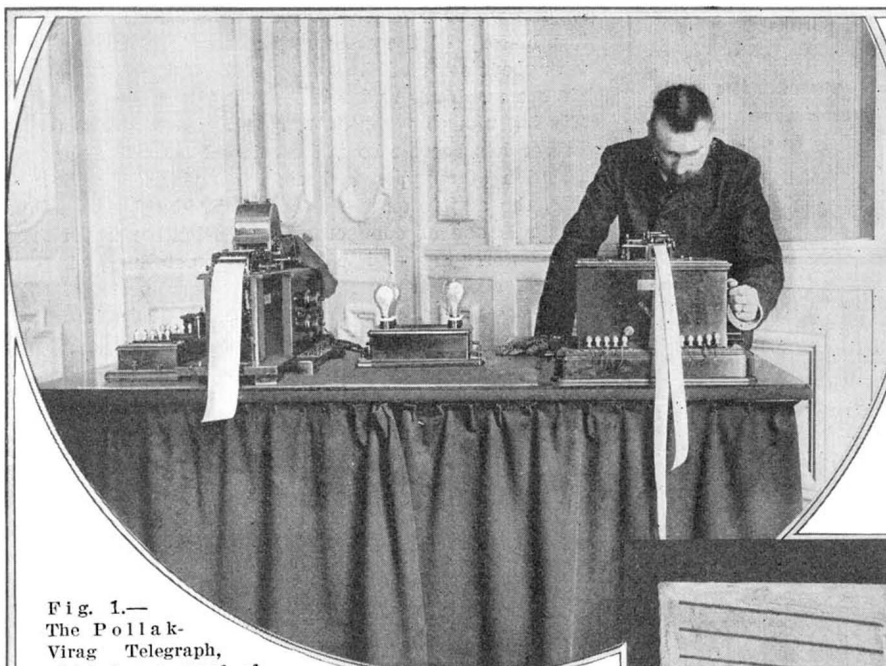


Fig. 1.—The Pollak-Virag Telegraph, which has a speed of between 40,000 and 50,000 words an hour, while the Baudot sends 4,000 and the Morse only 400 in the same time.

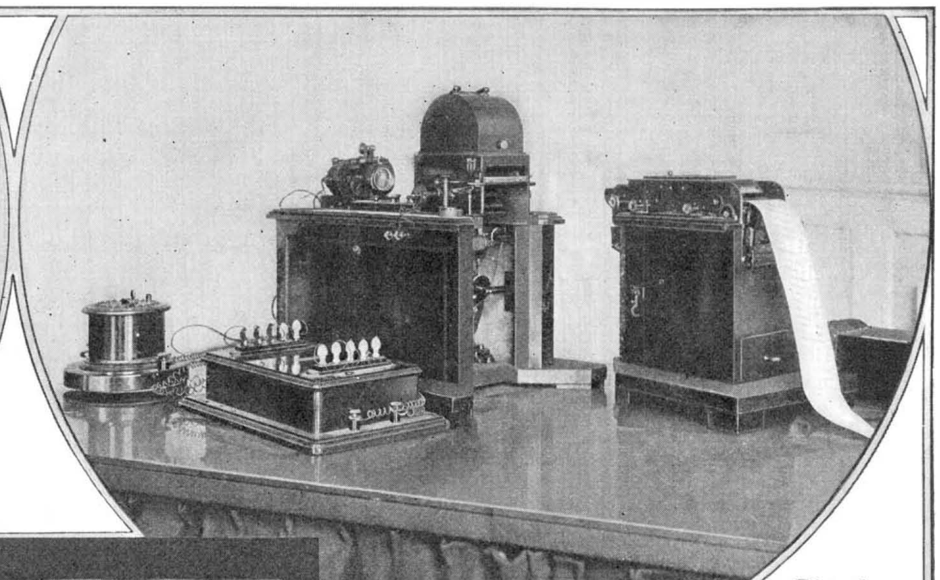


Fig. 2.—The registering apparatus consists of a mirror upon which a ray of light falls. The mirror is electrically displaced and the beam of light from the mirror writes on a piece of sensitized paper.

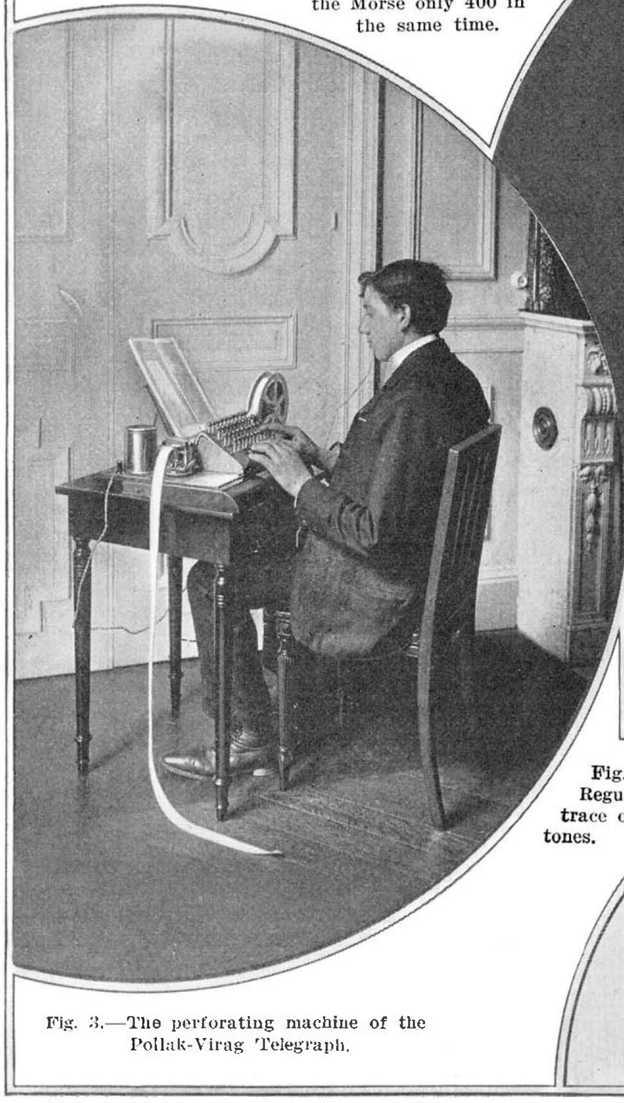


Fig. 3.—The perforating machine of the Pollak-Virag Telegraph.

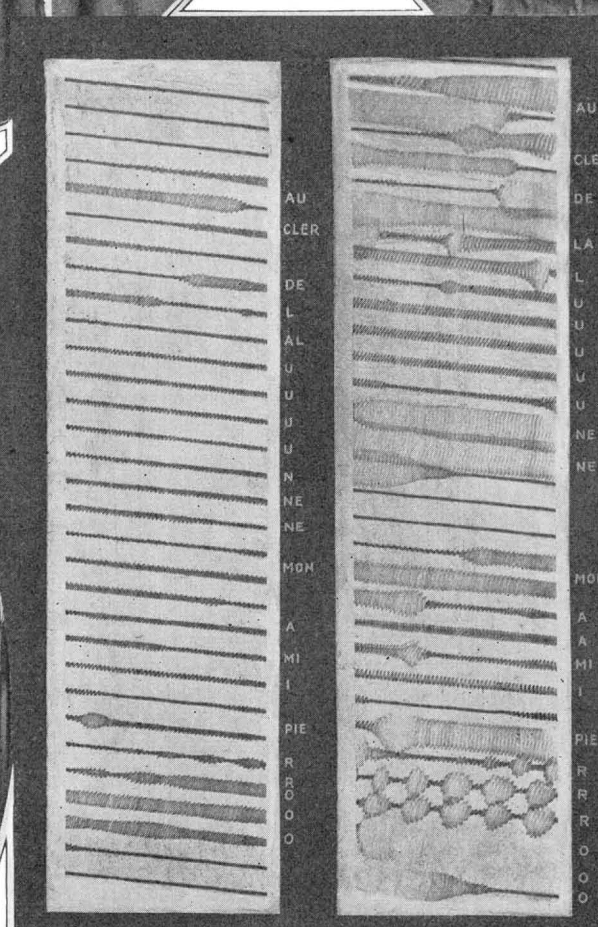


Fig. 4.—Regular trace of tones.

Fig. 5.—Irregular sinuosities of tones.

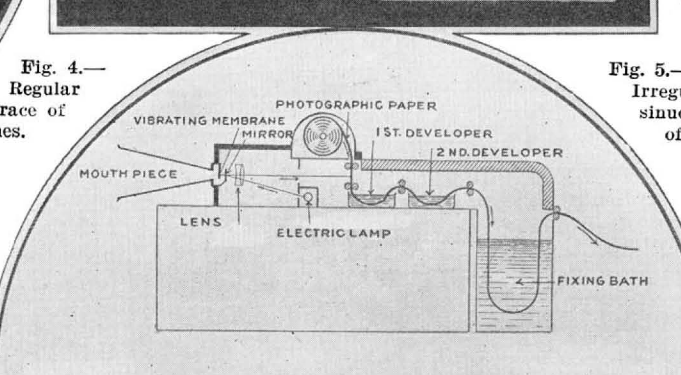



Fig. 6.—Making a record of the human voice.

Photographing speech.

cuit. In the last place the writing of the message works in the following way: Light from a point of the filament of an incandescent lamp passes through an aperture in a screen and falls upon a strip of photographic paper, reflected by a little mirror whose back face of iron rests upon three magnetic points.

The diaphragms of two receiving telephones being put in motion by the electric currents of the transmitting telegraph, communicate to the mirror by means of two little stems (tiges), slight displacements at right angles to each other.

As a result of the rotation of the drum and the repeated movements of the luminous points from left to right on the sensitive paper, as well as of the advance of the latter, inclined lines are written on the photographic band as long as the mirror remains still. But when this mirror moves under the action of the vibrating diaphragms the luminous ray writes letters following these inclined lines. A window furnished with a red glass permits one to follow the displacements of the incandescent point, which appears as a sort of writing flame.

When the dispatch is entirely transmitted a knife cuts the strip, which has now only to pass through the photographic baths.

Mr. Pollak has overcome many difficulties to make this last part of his telegraph easily usable. In the first place, the duration of the exposure is very short. In other words, the time during which the luminous point is moving upon a surface equivalent to its own size does not exceed 3/1,000 of a second. In the second place, the photographic processes must go very rapidly, for the accumulation of sensitive paper in the developing and fixing baths would be a difficulty which would rob the system of most of its advantages. The inventor has succeeded in this delicate undertaking. He has invented a device which effects the development in five to six seconds, the fixing in six to seven seconds, and furnishes the messages ready to be delivered to their destinations. In truth, the surface of the gelatine comes out slightly damp, but with blotting paper it can be dried immediately, so that telegrams do not need any further manipulation before being given to the messengers. Besides this, the machine develops and fixes bands of small size as well as strips 25 meters long and .07 meter wide, containing about 10,000 words.

Thus, the Pollak-Virag telegraph shows great advance over its predecessors. Unfortunately, there is some shadow over the picture. Indeed, iron wires or ordinary cables could not be employed when great distances are involved. Such wires do not permit the passage of interrupted currents at the required frequency of 300 to 400 interruptions per second. The wires ought to be of bronze. However, in spite of this transformation of material, the Pollak-Virag devices retain their economic advantage, for with two wires they permit the sending of as many words as a Hughes telegraph employing twenty wires; their substitution for the other systems will have to come in the future, without taking into consideration that with them half as many employees are sufficient to transmit the same amount as with the Hughes system.

Finally, these ingenious mechanisms devised by Mr. Pollak and his friend Virag have permitted Dr. Marage *to photograph speech.* The diagram and the photograph (Fig. 6) make it possible for us to understand the arrangements which he employs. The novelty introduced by the eminent French investigator consists in the suppression of the manipulator. He replaces it by a microphone put in communication with one of the two receiving telephones, the one which gives vertical oscillations. The telephone then transmits the vibrations of the words to the movable mirror and the luminous ray photographs itself on the paper. Each line of the inscription obtained corresponds to a quarter of a second.

Thus, one has all the elements necessary for appreciating the qualities of a voice. In fact, to know the duration of each tone it is sufficient to count the number of lines inscribed by the vibrations. If there are three lines, the tone lasted three fourths of a second, if there are four lines the tone has been emitted four fourths of a second; that is to say, one second for each line lasts one quarter of a second.

On the other hand, the regularity or irregularity of the vibrations attests the homogeneity or non-homogeneity of the sound.

At last, to appreciate the precision the number of vibrations corresponding to each of those is calculated. For that the number of vibrations traced upon a line is counted and multiplied by four, which gives the number of vibrations per second. As for the time elapsing between two consecutive tones the measure of the straight line separating each of them, and showing that there was no vibration in the interval, gives it immediately.

If a singer sings a scale without interruption between the tones, and if he possesses a voice of good quality, a regular trace will be obtained (Fig. 4), while if the vocal cords are badly used or tired, irregular sinuosities will appear upon the paper (Fig. 5).

*We have submitted Mr. Boyer's account of Dr. Marage's experiments to Dr. Floyd S. Muckey, a well-known throat specialist and authority on the human voice. Dr. Muckey comments as follows: Oral speech is composed of vowel and consonant sounds. Vowel sounds are musical tones, that is, the vibrations or air waves follow one another at regular intervals. On the other hand, the consonant sounds are largely noise, the vibrations occurring at irregular intervals. It is thus clear that there must be a marked difference in the composition of these two classes of sound. It is also a well-known fact that the various vowels and consonants differ from one another as to the elements of which they are composed. For example, it is the difference in the number and the relative intensities of the partial tones which enables us to distinguish one vowel sound from another. The ability to convey ideas by means of vocal sound depends absolutely upon these fundamental differences of speech.*

*A photograph to be of any value must differentiate the various elements impressed upon the sensitive plate. A photograph of the face should enable us to distinguish the mouth from the nose, eye, chin or ear, otherwise it has no value. In a similar manner a photograph of speech should enable us to distinguish the vowels from the consonants and the various vowel and consonant sounds from each other. A critical study of the two so-called photographs of speech by Dr. Marage discloses no such differentiation.*

*For example, we have the same regularity of vibration in both vowel and consonant sounds. Some of the consonants show an increase in the intensity of the sound (indicated by the increase in the amplitude of the waves, especially the "p" and the "r," but this is not necessarily a characteristic of consonant sounds. "k," "d," "l," "m," and "n" have absolutely nothing in the photograph to indicate when they occur. The vowel sounds in "au," "cler," "de," "ne," "mon," "a" in "amie," "ie," and "o" in "Pierrot" apparently have exactly the same composition, viz., a fundamental and one overtone. The vowel "u" in "lune" and "i" in "amie" evidently consist only of a fundamental tone. Our study, therefore, shows that there is nothing in this photograph—considered without the accompanying text—which would enable us to translate these wavy lines into speech. It therefore is not a speech photograph.*

*The apparatus used by Prof. Hallock and myself in studying the voice, and described a few months ago in the* Scientific American, *disclosed the presence of from four to eight partial tones in the various vowel sounds, each vowel having its own particular combination of partial tones. In one photograph the amplitude of the vibrations is greater than in the other. This simply shows greater intensity of the tone. That in which greater amplitude is manifest cannot show any diseases of the throat, as claimed by Dr. Conta, since the same result (intensity of tone) could be obtained by a perfectly healthy throat. It can, therefore, be of no service in diagnosing diseased conditions of the vocal mechanism.*

*Prof. Dayton C. Miller of Case School of Applied Science, Cleveland, O., obtained some time ago by his extremely sensitive phonodeik photographs of spoken words as well as tones sung under varying conditions, and his photographs are, I judge, even more tell-tale than Dr. Marage's, for the sensibility of his apparatus seems greater. But although Prof. Miller has analyzed tens of thousands of complex sound curves, he finds the greatest difficulty in analyzing these curves of a nature similar to those here given by Dr. Marage. So that it seems a little optimistic to conclude that these photographs will give to the amateur in mathematical analysis a simple means of determining the necessary corrections in speech and singing voice. There is no doubt that they are illuminating in a general way to anyone who has made a study of the optical analysis of sounds, but I doubt if they can be made of very general and accurate use by the laity.*

Up to the present Dr. Marage has not codified the rules which will permit by simple inspection of a vocal photograph to tell the words or the tones which it represents. He has not yet completely deciphered these hieroglyphics of a new type, but without doubt his devices which disclose the least imperfections of speech will help teachers of singing and diction in their often arduous task. Thanks to original combinations of the expert in acoustics, the Mounet-Sully or the Alvarez will easily correct the faults of their pupils, and certain Parisian practitioners—for example, Madam Dr. Conta—already employ it to study the voices of their patients.

## The Current Supplement

A most interesting and timely article in the current issue of the Scientific American Supplement, No. 2059, for June 19th, 1915, is that which describes the shrapnel shell, of which so much is said in the newspapers, but of which the public has little definite information. This article gives a thorough and practical description and explanation of every part, with excellent illustrations. It is most valuable and readable, and will be followed by other articles describing the various processes of manufacture. The Chemical Industries of Germany cover most exhaustively an important economic subject that affects a very wide range of industries and a multitude of people in many countries. For many years there have been people who have felt that some means might be devised by which all human senses could be pleasantly affected, or gratified, at the same time; and it has been generally accepted that music is the art that lends itself best as a foundation for such a plan. Naturally, the first impulse is to combine the sense of sight with that of sound, and efforts to give a color interpretation of music, along with the audible rendering, have been made on several occasions. The discussion in the article on "The Art of Mobile Color" will be found an exceptionally able discussion of the theories and principles involved. The Science of Cipher is an interesting discussion of the general subject of cryptographs, or illusive writings, with explanations of several systems and methods of deciphering them. In the Earth Considered as a Heat Engine we have a scholarly contribution to the geological history of the world. Another interesting article tells about some of the mechanism employed in moving-picture machines and scientifically describes an unusually ingenious improvement recently made. The use of rubber has become so universal and extensive that the question of supplies is becoming serious. In view of this, the article on the Artificial Production of Caoutchouc is one of commercial and scientific importance. The interesting article on Electrometallurgy is concluded, and there are other articles treating of color sensitive plates, star clusters, and other worth-while matter.

## Remarkable Oil Fields in Texas

The new oil field recently opened up near Thrall, in Williamson County, Texas, with such a remarkable production, is unlike any oil field in the United States, according to a report just issued by Dr. J. A. Udden, geologist of the Bureau of Economic Geology and Technology of the University of Texas, after an extensive investigation.

The peculiarity of this field is the fact that the oil is held in an igneous rock found in the lower portion of clay known as Taylor marl. This igneous rock was probably poured out as a basaltic lava by a submarine volcano in the sea of an earlier age. It was buried under the heavy sediments in this sea and has since changed from a partly glassy block basalt to an impure serpentine which is green. This alteration was doubtless caused by partial decomposition of the basalt or trap rock. While this change was in progress oil probably filtered into the rock, coming from the surrounding marls and clays, which still contain many remains of once living animals, mostly of microscopic size.

From the outcroppings on the surface of this basalt it is surmised that the oil belt extends many miles to the south, then turning west, which belief is supported by the fact that oil has been located in great pools at various points along this belt.

## A Metal Famine in Germany

The London *Daily Telegraph* reports that the *Berliner Lokal-Anzeiger* appeals to the people for contributions of metal to the local mint. Silver is urgently needed owing to the failure of the American supply, and even lead is apparently at a premium. The public is urged to hand in plate, medals, silver ornaments, bottle-stoppers, and even lead soldiers. An office has been established in Berlin for receiving such contributions. The metal thus received is sent to the State foundry at Freiberg, Saxony, where it is cast into ingots and added to the mint reserve. Appeals have been made to the pupils of many schools to sacrifice their lead soldiers for this purpose, a fact which clearly points to the serious dearth of lead in Germany. The only metal not required is scrap iron!

**Corn-handling at Carnarvon.**—A 30-ton per hour intake plant was recently erected by the Spencer works for a Carnarvon establishment for unloading corn from vessels and delivering it direct into the mill. The elevator is of the balanced girder type and the grain is delivered from the head through a telescopic shoot into a hopper on the quay edge, thence to an underground band conveyor which takes it direct into the mill, where it is distributed by a number of elevators to the various departments of the mill as required. Such plants are of the most improved English design for handling grain in bulk.

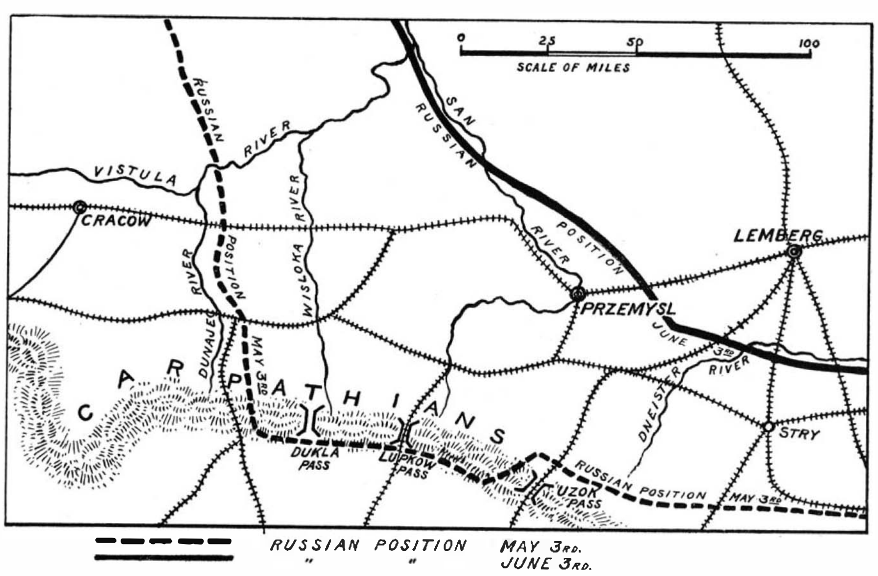
# The Strategic Moves of the War

By Our Military Expert

FOR another week, despite the entrance of Italy into the great European conflict, the eastern theater of war has been the storm center. The avalanche of Teutons that has been sweeping over Galicia, crushing and grinding or driving ahead of it the stubborn Russian defense, appears to have gained, rather than lost, momentum in its advance. No barrier, whether river, field trench or permanent fortification, has been strong enough to do more than give it a temporary check. The larger part of the spoils Russia secured by many months of hard and persistent fighting, at the cost of hundreds of thousands of lives, has been wrested from her by the Germans in the short period of one month. A great fortified city that withstood a Russian siege for nearly seven months before falling was recaptured in as many days. Considering the magnitude of the forces engaged, the annals of war probably furnish no more brilliant campaign than this German drive through Galicia.

At the beginning of May the Russians were in possession of the Carpathian passes—the doorways into Hungary—and her further advance over the southern plains appeared to be comparatively easy. Her position at that time is shown on the accompanying map by the dotted line. The portion of this position along the Carpathian Mountains ran nearly east and west, while the portion to the north ran nearly north and south. This right angle bend in the line gave German leadership the best opportunity it has had so far to demonstrate whether it is worthy of the faith placed in it. A better place than Cracow, with its splendid railroad facilities, would be hard to find at which to concentrate the enormous force that was to make the drive. It was near to and directly in front of that part of the Russian north and south line which invited attack. Running to the east and connecting Cracow with Przemysl were ample railroads for supplying the driving force during its advance. To the north was the Vistula River, affording a large measure of protection for the left flank of the advancing Germans. And, finally, the drive involved no great risk. If it succeeded the results would be decisive. If it failed, the German strategic situation would be none the worse for the effort. The chances were greatly in favor of success. So great was the opportunity that it scarcely could have been improved had the Germans deliberately led the Russians into the trap.

The advance began about May 3rd. By June 3rd, Gen. von Mackensen, with the assistance of his Austrian allies, had fought his way for 125 miles eastward of Cracow to the full line marked on the accompanying map. The Russians opposed him most stubbornly but unsuccessfully on three successive strong natural lines formed by the Donajec, Wisloka and San rivers. The last of these positions was greatly strengthened by the fortress of Przemysl, but this also was captured, not by slow siege operations, but by impetuous assaults extending over some days, which recall the spectacular taking of Antwerp earlier in the war. In the meantime, the extreme eastern wing of the Russian army in Bukowina was gaining victories against the Austrians on the Pruth and Dniester, in an effort to relieve the pressure on the Russian line in the Carpathians and farther to the north. But the Germans did not permit this to divert them from their main purpose, and the Russian east wing finally became involved in the general defeat and retreated north and east. A united and victorious German and Austrian army is now advancing on Lemberg from west and south.




Driving the Russians out of Galicia.

Why this terrible disaster to the Allies? Aside from the faulty Russian alinement, it would appear that the Russians lost the initiative by the period of inaction that followed their successes up to the taking of the Carpathian passes. Not until the war is over will we know the Russian plan for the conquest of Hungary, but a very probable conjecture is that the activity of the Russian east wing was the first move in a general advance which was to be taken up in succession by the center in the Carpathians and the right wing farther north. For a brief period there was some doubt as to which would hold the initiative—the Russian drive in Bukowina at the extreme east of the line or the German drive in Galicia at the extreme west of the line. The more favorable strategic direction of the German drive was the main factor in leaving the initiative with the Germans.

But we must seek farther for the real reasons for the German victory, and some of the more important of them antedate the war and had their origin in the conference room of the great German General Staff and the council chamber of the German War Lord. The developments of time and the magnitude of the war have given it characteristics quite new in warfare. The German imagination appears to have grasped these, if not perfectly, at least better than that of the Allies. The Allies admit that ammunition shortage was one of the powerful causes of the Russian defeat, and it might be added that an abundance of ammunition for the German guns contributed largely to their victory. German foresight, organization, and enterprise have been sufficient to provide necessary ammunition without the assistance of the outside world so extensively drawn on by the Allies. The German also appears to have realized better than the other contending powers the important part heavy artillery would play in field operations and was prepared for this innovation. To deliver ammunition to the front in sufficient quantity to replace the enormous expenditure of the modern battlefield is a task no less difficult than that of making the ammunition in the first place, and is not possible without an elaborate system of railways, perfectly operated. Truly, this is a war of wits as well as of numbers.

So far the Italian invasion of Austrian territory has furnished us with nothing spectacular. This certainly is not due to lack of preparation by Italy, for she had ample time during the diplomatic negotiations preceding her entry into the war in which to complete all her arrangements for striking swiftly. Nor does it appear to be due to inactivity of the Italian army nor any serious opposition of the Austrian forces on the Italian frontier. Nature is the great ally of the Austrians in this theater of war and the Italians have encountered more opposition from her forces than from Austrian bullets. The Italian frontier was fixed by Austria to suit her own military ends. From Switzerland to the Adriatic Sea it follows the southern or Italian slopes of the numerous chains of the Alps. For many miles (in some places as much as three hundred) back of the frontier line on the Austrian side, one mountain chain succeeds another in a confused mass of precipitous heights and narrow valleys, with few good wagon roads and fewer railroads. Strategically, this frontier is greatly to Italy's disadvantage. It can be crossed only at the mountain passes which can be defended with comparatively weak forces. Between the passes are wide stretches of country, practically impassible to troops operating in large numbers. In short, Italy is confronted with all the difficulties, strategical and tactical, incidental to mountain warfare. The portions of her army advancing through the various passes cannot co-operate with certainty and are in great danger of being beaten in succession before assistance can reach them from the neighborhood forces. In one of Napoleon's early campaigns in this same region he defeated a superior Austrian army when it was divided into two parts not in supporting distance of each other, by attacking each of the parts in succession. The Tyrol is thrust like a dart for a hundred miles or more into northern Italy, and Italian columns advancing through the passes on the edges of this dart must meet on hostile soil before they can work together as a team. This will be a difficult and hazardous operation in the face of a centrally located Austrian force, which can strike the Italian columns one after the other.

The problem of supplying the advancing Italian columns will be most difficult. Not all of the passes have railroads through them or even near to their Italian entrances. To haul the supplies for a modern army over wagon roads for more than a few miles from a railroad terminus, even when the roads are good and plentiful, is a task of such magnitude as to make the boldest commander hesitate. The farther the army advances the more difficult it will be to forward food, ammunition and reinforcements, and when fighting begins the task is increased by the necessity of sending the wounded to the rear. In the passes and within the perimeter of the dart are fortifications that must be reduced and large caliber guns must be supplied in large numbers for this task. This means that vast quantities of bulky ammunition will make further demands on the transportation facilities which may well overtax the capacity of the available roads.

A reverse in such a region may easily become a disaster. A retreating army must pass through the same doorways by which it entered. At the critical time when it is most necessary to concentrate to check a victorious enemy, it may have to separate to save itself. The knowledge that escape from this region is possible only by way of a few narrow passes which may be barred might make an army fight with the courage of desperation, but it may easily have the contrary effect. The dangers of the situation will affect all ranks from commander down. The Russians in the Carpathians were in just such a situation a few weeks ago when the German drive from Cracow began to succeed and threatened to close the Carpathian passes behind them, while they were being attacked in front by the Austrian army. To save themselves they beat a hasty retreat which, for parts of their army, became a rout.

Even with a united army, fighting through these rugged mountains would be a slow and costly procedure. All the modern weapons of warfare must be used here the same as on the gently undulating lowlands. The cavalry cannot be dispensed with, yet it will be next to impossible to support it. Artillery, from the numerous field guns to the fewer but ponderous siege guns, is indispensable, though the guns may be advanced but a mile or so each day. Tactical combinations which will win decisive victories are next to impossible in the face of an active enemy. It probably will be sledge-hammer work, one day after another, success being merely the capture of one mountain fastness only to find the enemy removed to another nearby.

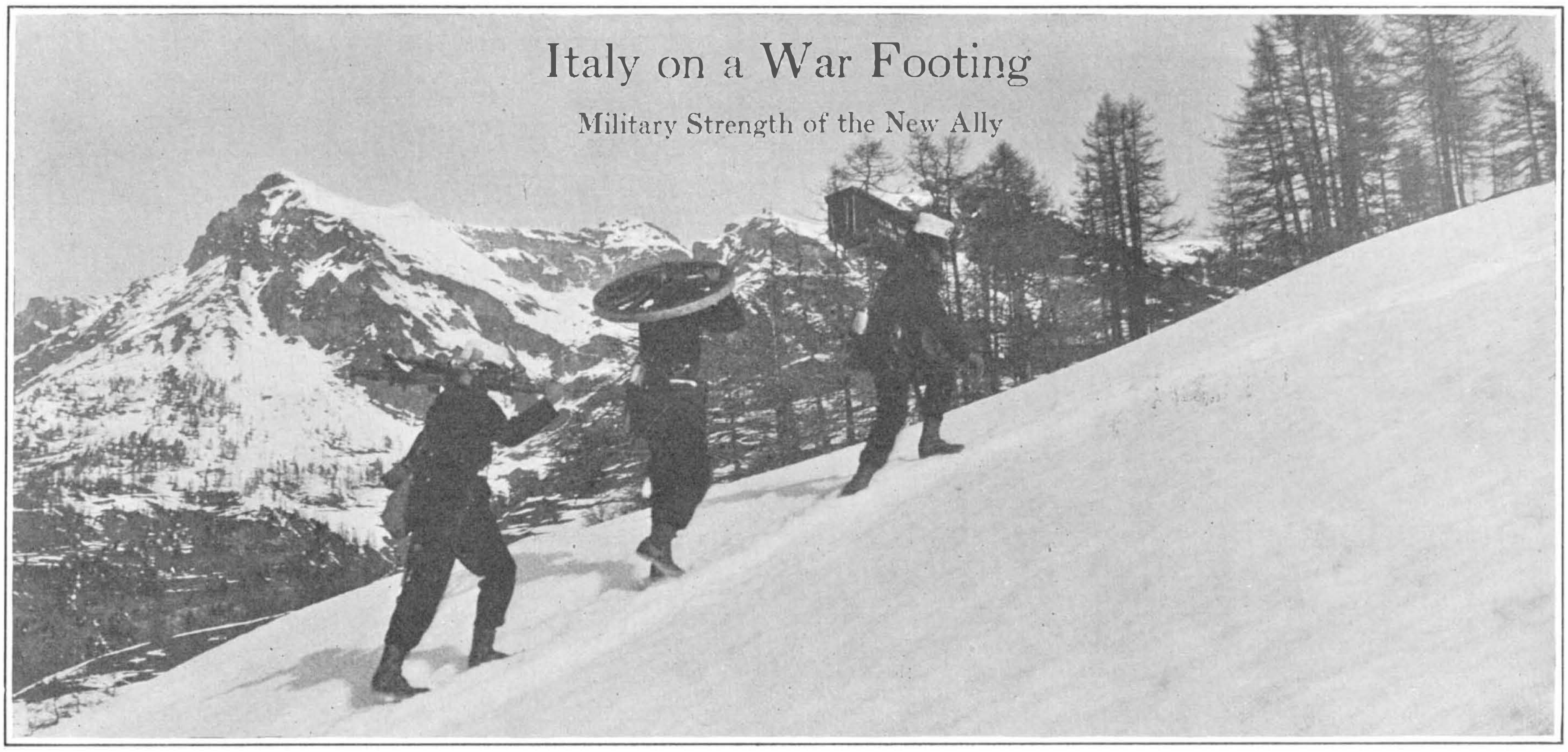
Italy's plan of campaign cannot be determined with certainty, from news had up to now. She appears to be advancing in two directions—to the north toward the Tyrol on a front fifty to one hundred miles wide, and to the east toward Trieste on a more narrow front. Whether or not she intends to advance in strength in both of these widely divergent directions may not be clear to the American reader for some weeks. To do so would mean either much greater strength on the part of Italy than Austria can bring against her, or a determination to take great chances. Certainly she has not yet been opposed by any considerable Austrian forces and probably will not be until Austrian territory is in more serious danger than at the present time.

The contending armies in the west have indulged in another week of whipsawing back and forth, with the advantages on the side of the Allies. This wearing down process, if continued long enough by the Allies and permitted by the Germans, might in time so reduce the defensive power of the German intrenched lines as to permit the Allies to break through and turn the Germans out of a considerable part of their long line, particularly in the north. More probably the Germans will take good care to strengthen their defenses and deliver counter-attacks in time to offset in a measure the advantages gained by Joffre's nibbling policy on the western front.

At the time this is written the German armies are in no great danger at any point and are having matters pretty much their own way in Russia and Galicia. With Russia short of ammunition for her army, which has not yet recovered from the disorganization of its recent disastrous defeats, the Teutons' best opportunity for some time yet appears to be to strike Russia a still more crushing blow, while holding their other opponents at bay with the smallest possible forces necessary for that purpose. At other times in this war the Russian army has shown wonderful recuperative powers, and the immediate hope of the Allies lies in her ability to do this again.

# Italy on a War Footing

## Military Strength of the New Ally



Photograph by Paul Thompson

**Mountain artillery carried on the back.**

THE Italian army is based upon a system of universal conscription, its military service being governed by a law passed in 1875. Under this law every man accepted for service served nine years in the Active Army and the Reserve, and for five years in the Mobile Militia, after which followed a period of nineteen years of service in the Territorial Militia. In 1907 to 1908 extensive modifications were made, and at the present time all able-bodied citizens are liable to nine years of service in the Active Army and Reserve (which includes two or three years with the colors), four years in the Mobile Militia, and six years in the Territorial Militia.

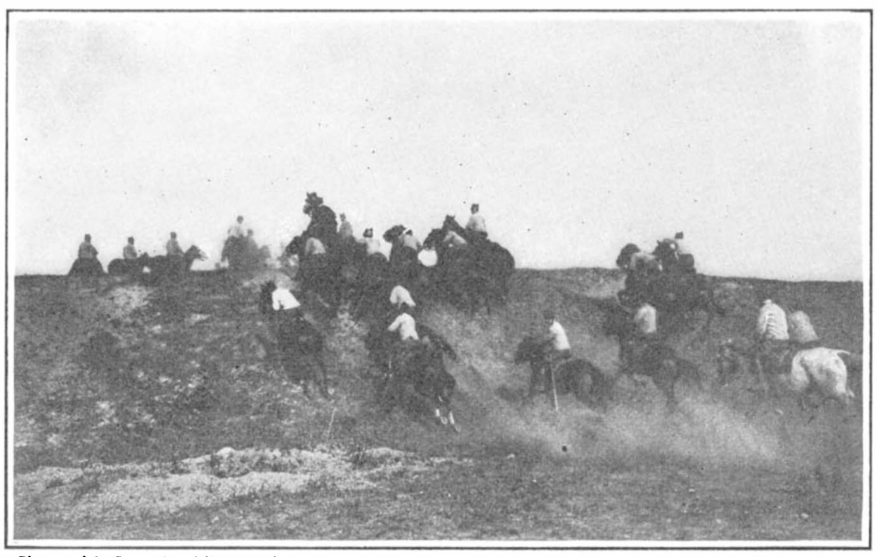
In the year 1901 the war strength of the Italian Army was estimated as follows: Officers, 36,718; Active Army and Reserve, 734,401; Mobile Militia, 320,107, and Territorial Militia, 2,275,631, making a total of 3,330,202 men of all classes. It was estimated, however, that when the re-organization of 1907 to 1908 had taken full effect, which it has done by this time, the Active Army and the Mobile Militia would be increased by about 33 per cent above the figures given for 1901. Hence, at the present time, the field army, including officers, should amount to a little over 1,000,000 men.

The army consists of 14 corps with 26 Alpine battalions; 38 Mobile Militia companies in the second line, and with 26 Alpine battalions in the third line. Behind these are 54 mountain batteries, 6 battalions of carabineri, and 23 battalions of custom guards, with militia formations back of them.

There are four armies in the field, each consisting of two to four army corps and one cavalry division. An army corps consists of two regular divisions, totaling 25,000 men, with 104 guns and 18 machine guns, or two regular divisions and an extra Mobile Militia division, in which case an army consists of 37,000 men, with 134 guns and 26 machine guns.

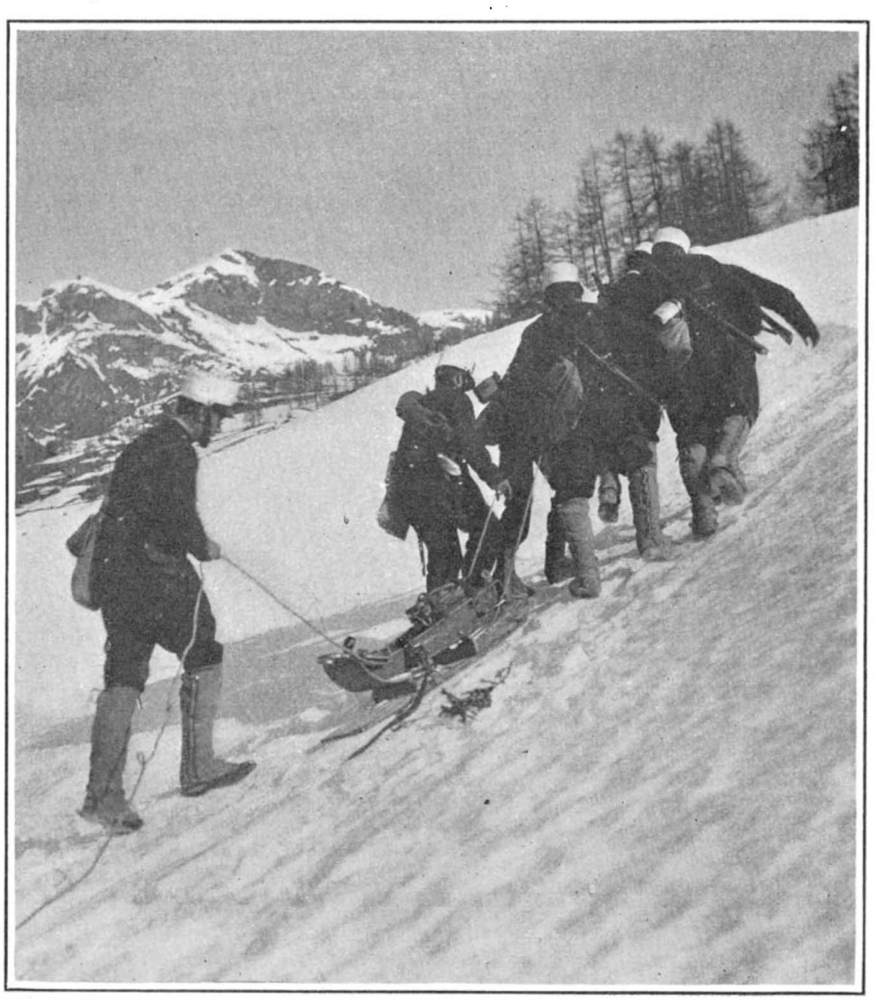
The geography of Italy, considered from the strategic standpoint, makes it necessary that the greater part of the army be stationed permanently within the reach of the northeastern and northwestern frontiers, and the principal headquarters are Alessandria, Milan, Genoa, Verona, Bologna, Ancona, Florence, Rome, Naples, and Palermo. The Alpine battalions above referred to, with the mountain batteries, are, naturally, stationed on the Alpine frontiers.

The infantry is armed with the Mannlicher-Carcano magazine rifle, using a vertical box containing six cartridges. The weight of the rifle without bayonet is 8 pounds 6½ ounces. Its caliber is 0.256 of an inch. The maximum effective range is 2,187 yards. It fires a round-nosed bullet weighing 163 grains with a velocity of 2,395 feet per second, and up to a maximum range of 750 yards the entire space under the trajectory is a danger space for infantry. This is a considerably larger space than that of any other European rifle, that for the English, French, and Belgian rifle being 640 yards, for the Russian rifle 620 yards, the German 610 yards, and of the Austrian 650 yards. It will be seen that the Italian rifle is characterized by small diameter and light weight of bullet, high velocity, and long danger space.



Photograph by International News Service

**Italian cavalry is famous for its horsemanship.**



Photograph by Paul Thompson

**Transporting mountain artillery.**

In 1909 the field and horse artillery of the Italian army was in process of re-armament with a Krupp quick-firer; but this gun has been replaced by the celebrated Deport 75-millimeter gun, with some Italian improvements incorporated which they claim have rendered this famous piece even superior to that now in use by the French on the western battle line. The siege guns are of 9-centimeter, 12-centimeter and 15-centimeter caliber, and the howitzers are of 15, 21, and 30 centimeters, the last named being a new gun which has recently undergone tests at Genoa and is said to have shown most excellent results.

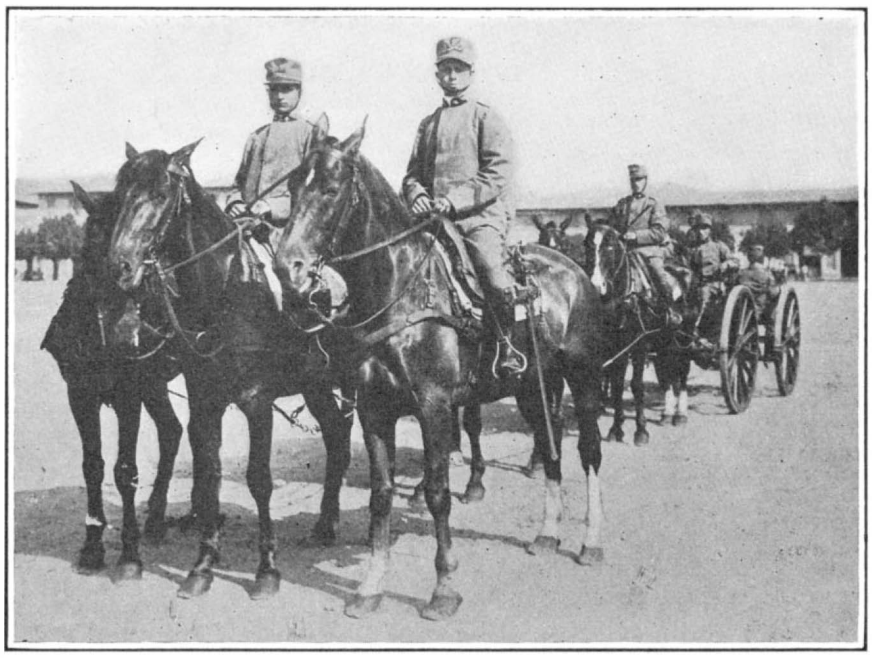
The new Italian army has yet to win its spurs under the severe ordeal of modern European fighting. A considerable number of first-line troops are veterans of the recent war against Turkey, but the bulk of the army has yet to receive its baptism of fire. So far as can be judged from press reports, Italy with its four armies of invasion, operating against Trent and Trieste, has been everywhere successful; but the crucial test will come when the Austro-German armies are encountered in full force.

There is reason to believe that the average quality of the Italian army is equal to that of any of the armies engaged in the present struggle. The Alpine troops have long been reckoned among the finest of the mountaineer soldiers of Europe. Equally well known are those picturesque troops known as the Bersaglieri (sharpshooters), of whom there are probably to-day in the Italian army, including those of the Territorial Militia, about 100,000. These troops were originally organized as a corps of sharpshooters by Victor Emmanuel in 1850. They first saw service and greatly distinguished themselves in

the Crimean war, and a detachment of them was aboard one of the Italian warships in the naval battle of Lissa. Their uniform is a dark green, with a felt hat carrying their distinctive badge, a full plume of cock-feathers.

The Italian cavalry has long been characterized for its fine horsemanship, and already it has done good work in the opening campaign on the Austrian frontier.

Italy has this in her favor, that from the very start she will have the advantage of all the valuable lessons which have been taught during the ten months of the present war—lessons as to the relative value of rifle fire, machine-gun fire, shrapnel and high explosive shell attack, and the reduction of permanent fortifications by heavy modern howitzers and siege mortars. It is probable that the Italian army has never been so efficient, well trained and thoroughly equipped as at the present time. During the next few months it will be determined whether Italy is to maintain or lose or enhance her position as a first-class military power.


Copyright by International News Service

Italian field artillery in transit.


Copyright by International News Service

Taking cover behind a bank of snow.


Machine gun drill in the mountains.

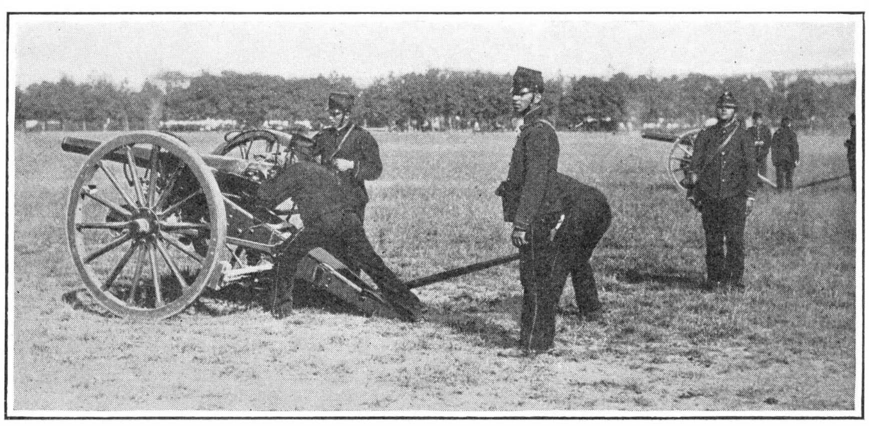
## Another Motor Truck Problem

In the issue of May 1st, the Scientific American called attention to several tendencies in the motor truck industry, which might be considered as indicating the arrival, or at least the dawn, of a new epoch in this important industry. The epoch can, of course, only be considered as such, in the United States; for in Europe, motor truck manufacturers, dealers, and users will find themselves confronted by a situation which, in its very nature, is absolutely unprecedented. The problems due to arise shortly, as a direct result of the great war, in the field of motor traction, will prove the most perplexing and difficult that any industry has been called upon to face since industries existed.

There are at this time something like 50,000 powerful motor vehicles in the armies battling for the mastery in Europe. Of these vehicles, considering the continued replacements and augmentations from the warring countries and from America, not less than 40,000 will be in a shape rendering them useful for commercial work after the war is ended. Careful students of the motor truck problem even admit that the number may be greater, due to the greater experience and greater care shown in the latter part of the war, as compared with the waste and destruction in the first two weeks.

When the war began there were about 25,000 commercial motor vehicles, including the London and Paris buses, withdrawn from service and placed in the field. The majority of these have been returned to their peaceful duties, and new specially designed vehicles have taken their places. What disposition is to be made of the 25,000-odd motor trucks manufactured since the war started, and used for the needs of the armies? To return the trucks to their former owners, against a reasonable compensation, would perhaps be possible in the case of those commandeered, but could not be done with trucks made especially for the army. It certainly could not be done with the 10,000 trucks purchased in the first nine months of the war from the United States. These trucks, overhauled as far as possible by military workmen, will undoubtedly be thrown onto the general truck market.

The total sale of commercial vehicles in Great Britain and France, together, in the course of a year barely reaches 10,000 trucks. If more than twice that number of capable tested motor trucks are suddenly released to be sold at the best price they will bring, one can imagine the chaos which will arise! Neither Great Britain, nor France, nor Russia—and probably not even Germany—would think of retaining all the thousands of trucks used as provision and ammunition carriers. They must be sold! And in the disposal of these vehicles in such an enormous number, compared with the total number in active work before the war, lies a menace to the European motor truck makers, which even at this time is causing the gravest apprehension. There will be few motor trucks exported from the United States—when the war ends!


Photograph by Medem News Service

The Italian 75-centimeter field gun.


Copyright by International News Service

Cyclist detachment of the famous Bersaglieri.

## Electromagnets for Experimental Work

Much time is often consumed in making electromagnets for experiments. It often happens that a large attractive power is not needed, and in this case it is an easy matter to make up an electromagnet, especially if there is a good current supply at hand so that the magnet need not have a great number of turns. Take a good-sized galvanized or other soft iron wire (about one eighth or three sixteenth inch) as a core. Were it bent as a horseshoe, it would be very hard to wind, but all that is needed is to insulate each end with paper and then wrap on rather fine wire without the use of a spool. After winding, bend the whole so as to make the usual U-shape. Although small, such a magnet has power enough for many usual purposes.

## Metallized Cartridge Shells

By the Schoop process, as has been described quite fully in the Scientific American, metal may be sprayed upon an object to form a thin plating or coating. This process is now being used in the manufacture of cartridges for rifles. Instead of using a solid metallic shell, paper cartons are employed, and these are covered with a thin layer of metal. Aside from the saving in copper or brass, the cartridge itself is lighter, so that a soldier can carry more of them than the old type.

## A Novel Dissolving Picture-projecting Apparatus

By Robert G. Skerrett

UNTIL very recently the trick of showing dissolving views by means of a stereopticon was pretty much a matter of sleight-of-hand. The operator in charge of the machine had to shift his slides manually, and the success of the effect hinged entirely upon his cunning of manipulation. In this age of mechanical wonders a procedure of this sort seemed exceedingly antiquated—at least that is the way the situation impressed Mr. Alfred Vischer, Jr., an undergraduate of Stevens Institute.

Being of an inventive turn of mind, this young man set about planning an automatic apparatus for shifting the slides and operating the shutters of a stereopticon. When far enough along, he laid his design before an established manufacturer of picture-projecting machines, but the latter declared the scheme impracticable. Coming from doggedly Dutch ancestry, Mr. Vischer decided to build an experimental outfit, and from that first endeavor has evolved his autoprojector, a commercial apparatus now generously endorsed particularly by advertisers.

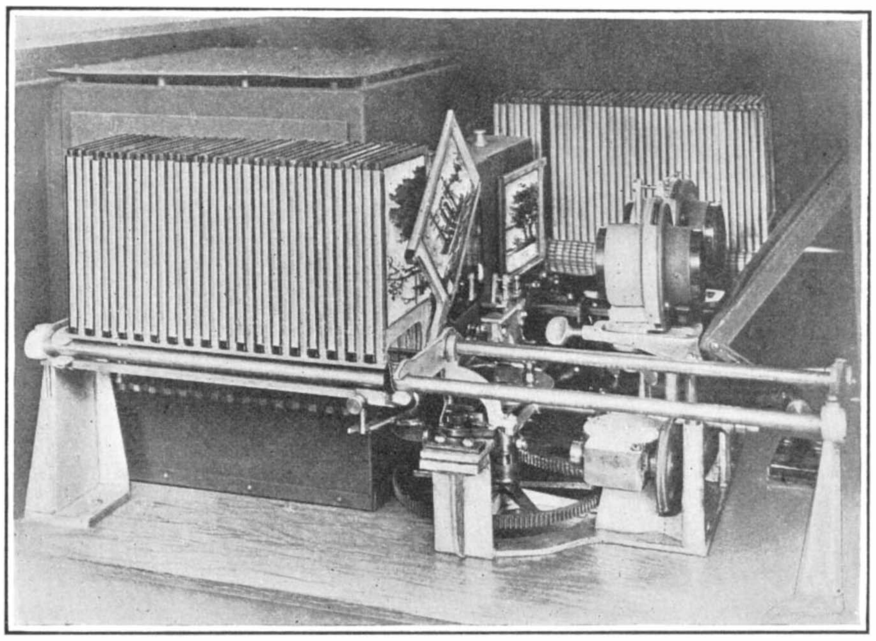
The inventor's first aim was to produce a machine for the lecture platform, but the immediate field of picture advertising made the stronger appeal. His outfit for the lecture platform is fundamentally like that for publicity work, except that the lecturer controls the period of exposure for each plate and, by merely pressing a button, can make the apparatus show again the picture immediately preceding the one at the time on the screen. This feature is a valuable one, and the confusion so often encountered where the slides are operated by hand is entirely eliminated.

Primarily, the machine consists of two flanking racks holding slides in pivoted aluminium frames which alternate in the order of display. Or, in other words, the odd numbers are on one side and the even numbers on the other. In turn, the slides are swung in a vertical plane across the face of the projector, each set of slides having its own lens, and as the shutter of the view already shown is closing, the diaphragm for the new picture is opening. In this fashion the dissolving effect is obtained gradually and smoothly and with perfect regularity. The slides cannot be dropped and the mechanical movement is so nice that there is not the slightest jar or vibration. The carriages containing the aluminium holders advance much after the manner of a typewriter carriage, and this progression is effected by gearing.

In the case of the lecture apparatus, the action is started by the pressing of a button and the picture remains upon the screen until the button is again pressed for the next slide or, as we have already said, for the reproduction of the previous picture; then another button in the same hand bulb is pressed. The disappearing of one view and the coming of another gives the dissolving effect. With the advertising machine, however, the period of display is uniform for all the slides, and they are shown continuously in any desired order so long as the apparatus is working. The actuating current is subject to automatic control, which can be set to stop the machine at any hour. This is particularly desirable where advertising is carried on after closing hours for the shops or other places of business where the apparatus is placed in the windows.

The autoprojector for advertising can handle any number of slides from ten to seventy-four, and the carriage feeds slides when advancing and retreating. By suitably alternating the holders to be brought into play, a circular succession, as it were, of the slides can be maintained continuously, thus insuring that the views shall follow in their logical or designed sequence. This is important, especially when the aim is to arrest the attention of the passerby and to show him the climacteric points in the story to be told graphically.

Mr. Vischer calls his outfit "movies for the advertiser," and his aim is to eliminate the progressive stages of the ordinary movies, which he terms lost motion, and to show those striking moments toward which the mind instinctively leaps. The operative cost is very modest, the maximum—depending upon current cost—would be about 8 cents an hour. The machine functions noiselessly, weighs complete about 75 pounds, and is compact. The autoprojector, when resting upon its stand, is something like 6 feet high, and calls for a floor space of less than 2 feet square. A 22-inch picture is thrown upon the screen, and the illumination is sufficient to make daytime projection vivid.

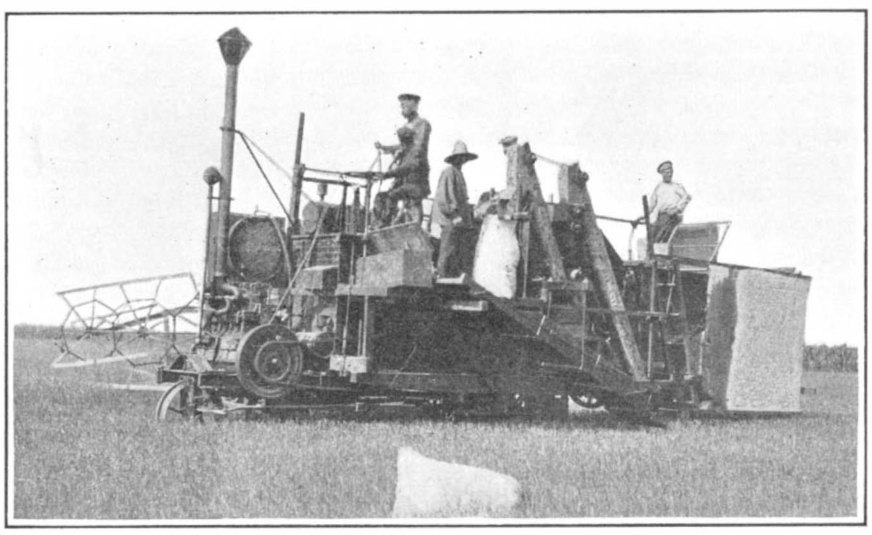


**The inner mechanism of the autoprojector, showing the lantern slides and holders, the guideways for the carriages, and the double lenses.**

## A Home on Two Wheels

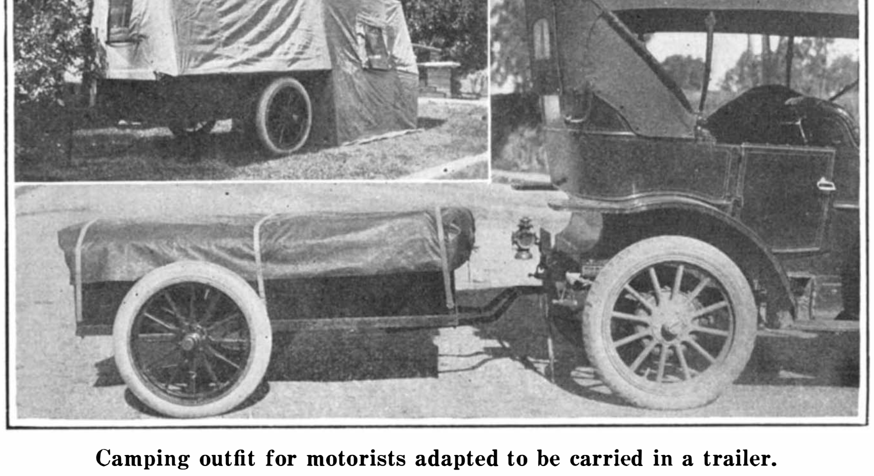
A LARGE tent house that can be folded up into small compass and trailed behind an automobile on a two-wheeled trailer has been devised by a Los Angeles inventor. Although it makes a commodious camp house with complete equipment for cooking and sleeping, yet every detail is so scientifically arranged that a very portable load is made of the parts within a few minutes after striking camp.

The trailer contains a tent, chairs, stove, ice-box, a table set complete, numerous cooking utensils, etc. The sleeping accommodations consist of one full-sized bed with mattress and two folding cots. The tent is rainproof, measuring 13 by 5½ by 8 feet high. It has three windows with screens. The ice-box contains five separate compartments, one for the ice, 10 by 14 inches; another contains a two-gallon water can. The camp house is electrically lighted. In fact, there are so many comforts of home that one can take an outing trip without any of the "roughing it" that one hears about in connection with such a trip.



**A harvester in Kief, Russia.**

An internal combustion engine supplies power, and the machine, propelled by a caterpillar tractor, cuts, threshes and sacks the grain.



**Camping outfit for motorists adapted to be carried in a trailer.**

## Harvesting Grain by Motor Power

YEARS ago, when the establishment of the grain raiser of the West grew from a modest farm of a few hundred acres to the immense ranch where it took an entire day to run a single furrow around a field, it became evident that the old-fashioned hand methods of plowing, reaping and threshing were entirely inadequate, not only because of the cost, but more especially because it was impossible to find enough men to do the work. This condition was met by the reaping machine, which later became a header, and was also combined with a thresher, thus evolving a harvesting outfit of great capacity.

These combinations were heavy to haul and also required considerable power for the various mechanical operations, and with increased demands for service the simple reaper requiring two horses grew to a huge machine drawn by thirty powerful animals; and here the limit in size and efficiency practicable with this kind of power appeared to have been reached. The steam engine appears not to have been suitable or desirable as a substitute for horse power, and even when the internal combustion motor became practical its use was confined to the operation of the mechanism but not the propulsion of the machine. All of this has now been changed by the improvements that have been made in heavy traction devices, and the latest harvesting apparatus is the complicated machine shown in the illustration that does everything but grind the grain which it gathers.

Harvesting that is almost automatic is now possible by means of a self-propelled combined harvester which has reached the commercial stage. Since the early eighties, when a header and a thresher were combined to make the horse-drawn harvester, three other machines have been incorporated, viz., a recleaner, a gasoline engine, and a "caterpillar" track, which propels the outfit forward.

The heads and a short section of the straw are cut by the header knife falling upon the draper, an endless canvas belt which elevates them to the feeder. Back of the feeder, a rapidly revolving threshing cylinder knocks the grain out of the heads. Revolving beaters, pickers, and endless straw carriers continue the separation, finally throwing the straw out at the rear of the machine, either in large bundles or a continuous windrow. The grain is elevated to the cleaner, thence delivered into sacks, which are still sewed by hand, and dumped six in a place on the ground. Unthreshed heads go back to the feeder for a second trip through the cylinder.

The separator is kept level on steep hillsides by a swinging frame which permits one wheel to be dropped and the other raised, the header meanwhile conforming to the slope of the hill, sometimes over 45 per cent. The gasoline motor was first added to horse harvesters to maintain a steadier motion for threshing, regardless of the forward progress of the outfit, and to reduce the animal power required. In the self-propelled harvester it, of course, furnishes power, not only for the cutting and threshing, as before, but also for propulsion.

Four men operate the self-propelled outfit, one driving, another tending the header, a third the separator, and a fourth sewing sacks. They put as much wheat into the sack in ten hours as six hundred men working with scythes and flails, with a considerable advantage in cleanliness of output.

The use of the motor and endless steel track for propelling eliminates from sixteen to twenty-six horses.

Combines have been common on the Pacific coast for thirty years, but the self-propelled machine is a commercial novelty within the last two.

## Removing a Statue From the Course of a Subway

THE new subway running across New York through Fifty-ninth Street passes under the site of the Sherman monument in Central Park Plaza. The weight of this statue and base was over three hundred tons, and it was found necessary to move the statue, as the rock formation above the roof of the subway was not strong enough to support the load.

The moving of this massive piece of sculpture a distance of 195 feet was effected without the aid of steam, electric or horse power, but merely by hand labor. The preliminary operations consisted in the removal of the granite steps surrounding it and the raking out of the mortar in all joints of the pedestal to a depth of at least an inch, in order to prevent spalling, that might be caused by excessive stresses, in the stones during the moving.

Upon completion of this work the foundation was cut out below one end of the granite pedestal, enough to permit the placing of a transverse needle, consisting of a pair of 12-inch I-beams bolted together. These needles were supported on jacks at each end and were brought to a bearing under the pedestal. An adjoining section of the foundation was then removed and a second pair of I-beams inserted and jacked up, and this operation repeated until six pairs of I-beams had been set. The monument was then raised, by means of the jacks, to a height sufficient to permit the placing of skids and rollers.

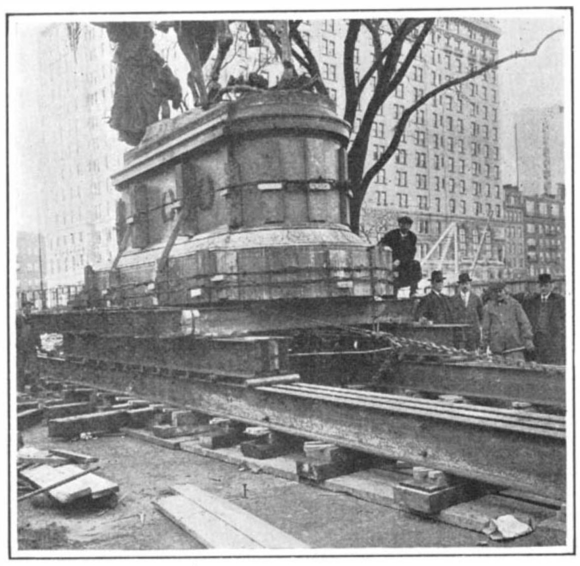
The skids upon which the monument was moved consisted of two sets of three 15-inch I-beams each, bolted together, placed longitudinally under each side of the monument. Over these, two 15-inch I-beams, bolted together, were placed longitudinally along each side to support the ends of the needle beams. Twelve 5¼-inch steel rollers were then placed between the upper longitudinal beams and skids. The skids were then wedged up and brought to a bearing and the jacks removed.

Two differential pulleys anchored some distance ahead were used to move the monument on the rollers. Two men to each pulley operated the windlasses on which chains revolved. In this manner the monument was moved to its temporary position over a concrete foundation which had previously been placed for its support.

Two pairs of 15-inch I-beams were then placed lengthwise along each side of the monument above the transverse pairs of I-beams; and the latter hung from these by means of 3-inch I-beams placed above the longitudinal and below the transverse I-beams and connected by 1-inch bolts.

The load was then transferred to jacks placed under the upper pairs of longitudinal I-beams, and the lower sets of longitudinal I-beams and the skids on which the monument was moved were removed. The monument was then lowered, by means of the jacks, to the required grade. Supporting piers of granite were then built under the monument and the load transferred to the piers by means of wedgestones. The jacks and needle beams were then removed and the granite steps replaced.

**The monument jacked up on the new site while the skids were being removed.**



**Moving the monument on rollers.**

**Laying the skids on which the monument was moved.**

## Swat the Fly Eggs

"SWAT the fly" is a good war cry; but it is like locking the stable after the horse is stolen. There is a better one—"Swat the eggs." Probably every magazine and newspaper in the United States printed last season from one to a score of arraignments of the common house fly—the disease-breeder, the typhoid fly; the infantile paralysis fly; in a word, the twentieth century pest, an enemy of mankind. "Swat the fly" has become the slogan of the day.

For every fly killed in May there will be ten thousand less in June, a million less in July, and by September the most ambitious boy, eager to earn the prize for the greatest number of flies killed, couldn't possibly lift the progeny of this single fly which escaped him in the springtime. All very true; but where will all these flies lay their eggs and rear their precious babies? Can we find the nests, can we destroy them by wholesale, the larvæ or the eggs? We can, easily and cheaply, and every city with ordinary regulations may become a flyless town. Flies breed in filth, principally manure, and the ordinary pile of stable manure will bring forth enough flies to keep five hundred families fighting the pests from morning till night. If one tenth of the money invested in fly screens were spent on killing fly eggs laid in manure piles and garbage cans there would be no need of the fly screens which keep out the flies and incidentally a large proportion of the cooling breezes of summer.

Our Government has carried on an extensive experiment with manure piles and the eggs which each female fly deposits therein by the thousand, and has found the remedy. It is ordinary borax, one of the commonest and cheapest of minerals, produced in abundance in the United States, and it takes very little to make the fly egg quite worthless as a future fly. Borax costs about five cents a pound, and the crude borax mineral, colemanite, considerably less, while three fifths of a pound sprinkled through 10 cubic feet—about eight bushels—of manure will kill 99 per cent of the eggs and maggots of the fly.

A long series of experiments looking to the destruction of fly eggs and fly larvæ in manure piles has been carried on under the direction of Dr. L. O. Howard, the entomologist of the Department of Agriculture, the manure being treated in boxes or cages, the collection of these resembling a group of huge beehives. The manure, well infested with fly eggs, was treated with borax, kerosene, potassium cyanide, formaldehyde, copper sulphate, Paris green and ten or a dozen other chemicals, but none gave satisfactory results except the borax. Strangely enough, the Isthmian Canal Commission larvicide, consisting of carbolic acid, resin, caustic soda and water, which kills mosquito larvæ in less than half an hour, had but slight effect upon fly larvæ.

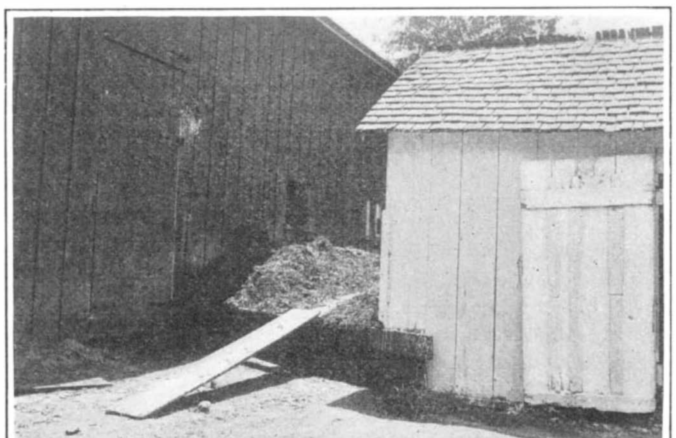
An important consideration in the borax treatment is in the effect on the manure. Some of the chemicals tested rendered the manure dangerous as a fertilizer, making it more harmful than beneficial to plant growth, but borax not only makes the manure possibly more beneficial as a fertilizer, but prevents burning or fire-fanging, a natural process with ordinary manure piles which considerably reduces the fertilizing effect.

The borax treatment is simplicity itself. Dr. Howard's advice is to apply 6 to 10 pounds of borax to every eight bushels of manure immediately upon its removal from the barn, sifting the borax around the outer edges of the pile with a common flour sifter and then sprinkle a large watering pot full of water over it. The flies lay their eggs on the fresh manure and the borax when it comes in contact with the eggs prevents their hatching. The few eggs which do hatch into maggots will soon or later encounter the borax, too, and die. The treatment should be repeated with each addition of fresh manure, since the eggs hatch out in one day, but remain in the manure as maggots for several days more. When the manure is kept in closed boxes or pits less frequent applications will suffice. Refuse and garbage should be treated in the same way. The cost of manure treatment is figured at one cent per horse per day.

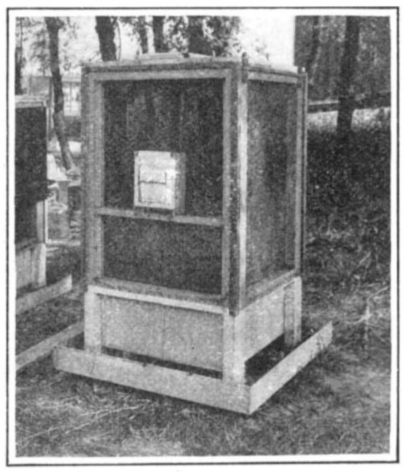
The borax treatment is so simple, so effective, and so inexpensive and so small a burden on the individual, that any community can enact and easily enforce regulations which will leave the fly without a breeding place; hence there will be no flies to swat.

## Feeding the New-born Infant

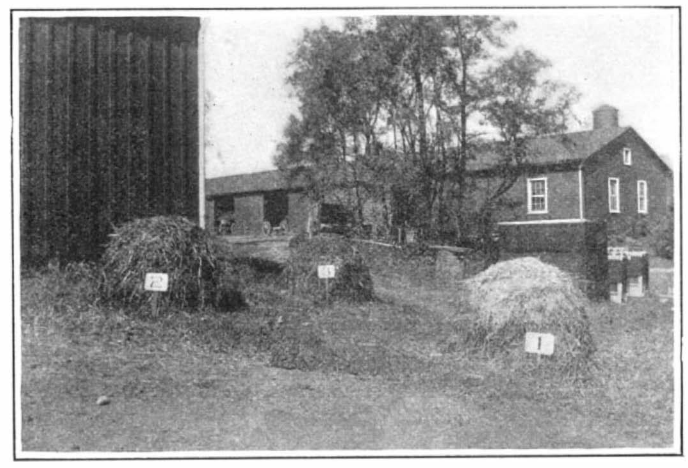
IN the light of some experiments on the energy requirements of new-born infants, studied in a respiration incubator, it is claimed by H. C. Bailey and J. R. Murlin that the breast secretion should be supplemented with artificial food during the first three days of life, as until the fourth day it is inadequate to supply the energy required by the infant. The respiratory quotient of the infant whose food is not thus supplemented shows a condition of starvation, with the combustion of fat, on the second and third days. Hence it is stated that "feeding the new-born infants for the first three days, in addition to the breast secretion, a formula of about the same composition as colostrum would appear to be a logical proceeding, not only to fulfill the energy requirement, but also to supply the water lost."



**Millions of flies breed in this small manure pile.**
A few pounds of borax would destroy this fly nursery.



**Cage used in the chemical treatment of manure.**



**Manure piles used in tests of fly larva destruction.**
Treated with dry borax. 2. Borax solution. 3. Not treated.

# Inventions New and Interesting

Simple Patent Law : Patent Office News : Notes on Trademarks

## A Remarkable Intermittent Mechanism for Motion Picture Projectors

By W. B. Morton

IN the production of motion pictures advantage is taken of the characteristic of the eye known as the persistence of vision. There is no actual motion of the rays of light forming the picture on the screen at all. Indeed, it may be said that to obtain perfect motion in the picture the film must be held perfectly still.

The motion picture film consists of a series of successively taken photographs of such small size that on a reel of standard length there are approximately 16,000 pictures, each differing from its predecessor by so small a difference that it is difficult to measure and quite impossible to observe by mere comparison.

By the operation of the motion picture machine the film strip is fed intermittently across the path of light of the arc lamp in such manner that each picture is brought to rest in the focal plane of the projecting lens, while the light from the lamp is cut off from the screen by the shutter of the machine and is maintained at rest for a definite period in which the shutter, usually a continuously rotating blade, uncovers the lens, makes its revolution, and again intercepts the light during the interval in which the film is advanced to bring the next picture into place.

The smoothness and exactness of operation of the intermittent gearing which drives the film feed directly determines the quality of the projection, as the "definition" of the picture depends chiefly on the exactness with which each picture is registered with the position of the preceding picture. An inequality of less than 1/10,000 of an inch in the engaging parts of the intermittent gearing can be distinguished in the appearance of the picture on the screen.

Not only must the intermittent be absolutely exact, but the experience of the first inventors in this field demonstrated the desirability of having the period of illumination as long as possible and the period of movement of the film as brief as can be obtained within the limits imposed by the fragile nature of the film and the speed of operation.

Prior to the invention by Mr. Nicholas Power of the recently patented intermittent gear forming the subject of this article, the greatest relative period of rest was three times the duration of the period of motion obtained with the well-known 4-slot Geneva gear (Fig. 1).

The next Geneva gear in ratio of rest to movement is the 5-slot Geneva gear. This gear, shown in Fig. 2, gives a period of rest four times as long as the period of motion, the total movement of the film taking place in one fifth of the time of complete revolution of the driving member. Hence, as pictures are exhibited sixteen to the second, the entire period of movement for each picture must be completed in 1/80 of a second.

Experience demonstrated that neither the film nor the machine would stand up with this movement, and as there is no Geneva between the 4-slot and 5-slot, it was believed that with the 4-slot movement the final development had been reached and for a number of years prior to the production of the Power movement, it was the intermittent movement of all commercial machines.

Mr. Power's first idea in developing the new intermittent was not so much to improve the Geneva gear as a type, but to produce a gear which would have a ratio between the two Geneva gears, and thereby obtain a greater period of rest of the film than the 4-slot Geneva without the destructive action of the 5-slot gear. The final result, however, of his study and experiment far exceeded his expectations; for in his latest model he has produced a gearing which has a longer period of rest than the 5-slot Geneva, and which nevertheless actually produces less wear on the film and less vibration of the machine than the 4-slot Geneva.

This form of gearing is shown in Figs. 3 and 4, and comprises a rotating driving member having a locking ring or flange extending throughout the greater portion of its circumference with a diamond-shaped driving cam in the gap intermediate the ends of the locking ring. The driven member, known to the trade as the "pin cross," comprises a 4-arm cross, each arm being provided with a pin to be engaged by the driving cam and locking ring. Each part is formed from a single block of drop forged tool steel to insure durability and reduce wear to a minimum.

The operation of the gear is shown graphically in Fig. 5, which shows different successive positions of the parts in a complete movement. In locking position all four pins of the cross engage the locking ring, two on each side as shown at position 1 of Fig. 5. As the diamond-shaped cam starts to pass between the pins of the cross the outer pin is engaged by the slightly curved outer face of the diamond, which produces the initial rotation of the pin-cross and causes the pins on each side of the pin to be engaged by the diamond into the slots between the driving cam and the locking ring as shown at position 2. The cam action of the inclined slots on the pins continues the movement of the pin cross through the various stages illustrated, giving the driven member of the intermittent to which is attached the film feeding sprocket an exact quarter revolution, at which point the locking ring is again engaged by all four pins, thus holding the pin cross absolutely stationary during the period of rest of the film.

The movement of the pin cross takes place during an angular movement of approximately 70 degrees of the cam, thus giving a period of rest even greater than the 5-slot Geneva, and yet it has been proven by a very interesting demonstration given at the recent Motion Picture Exhibition at Grand Central Palace that the new movement produces much less wear on the film than the 4-slot Geneva of other machines with the 90 degrees period of movement.

The reason for this superiority is that the new movement has been designed to give to the driven member an absolutely uniform acceleration in speed starting from its position of rest and an absolutely uniform retardation back to locking position, so that the driving power required is the same throughout the entire period of acceleration. In other words, the new gear utilizes the entire period of operation to the maximum degree, whereas the Geneva gear, which has a slow rate of acceleration at the start of the movement and also at its period of greatest velocity, must make up for these periods of understrain, when the rate of acceleration is small, by an intermediate period of severe overstrain in order to accomplish its full movement in the allowed period of time. In designing the new gear Mr. Power has adapted to the rotative movement of the intermittent gear, the laws of movement of a freely falling body whose velocity increases uniformly in successive periods of time under the force of the weight of the body which, of course, remains constant during its entire downward movement.

In the projection of motion pictures the new Power intermittent accomplishes three notable results. Its longer period of rest allows a longer period of illumination of the screen with brighter pictures and greater definition as well as less consumption of lighting current. Its uniform action produces less vibration of the machine, increasing the steadiness of the picture to a marked degree. Finally, the important fact of its easy action on the comparatively fragile film extends its life and usefulness.

Readers of this article who wish a more detailed analysis of this remarkable mechanical movement and a curve comparison of the time relations in the standard and the new Power intermittent gears, are referred to the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT, No. 2059.

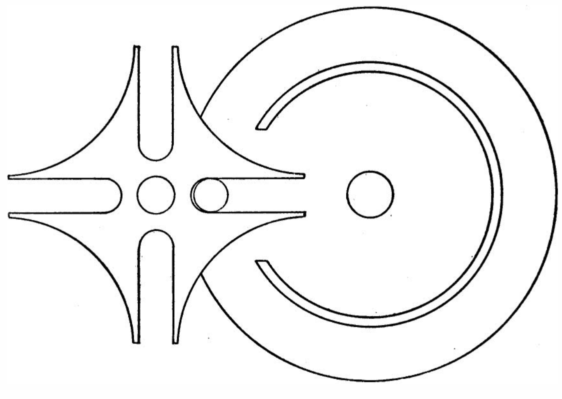


Fig. 1.—The standard four-slot Geneva movement of motion picture projectors.

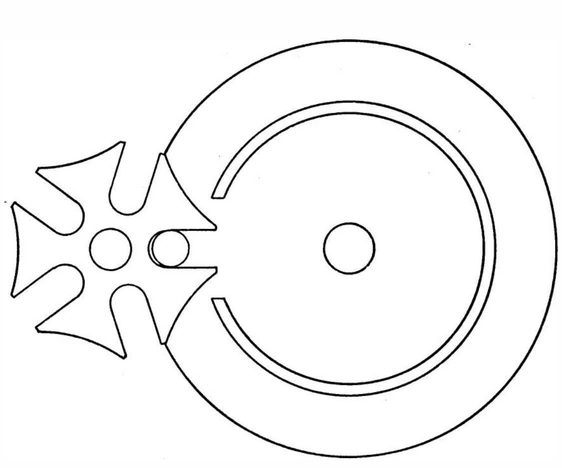
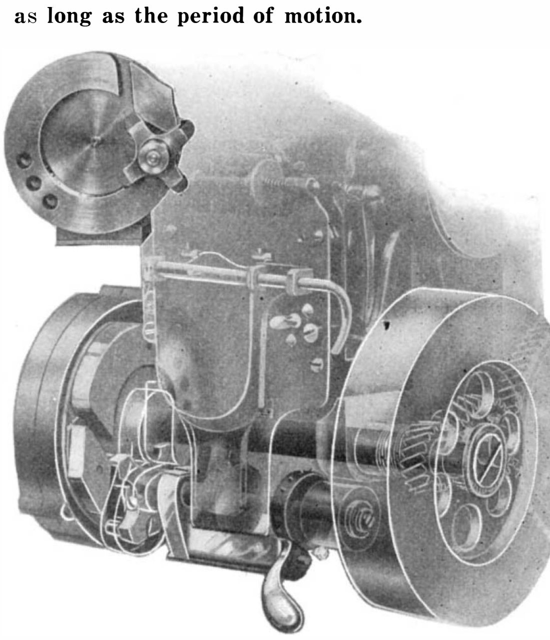


Fig. 2.—The five-slot Geneva gear, which gives a motion picture film a period of rest four times as long as the period of motion.



Figs. 3 and 4.—The new Nicholas Power intermittent movement for motion picture projectors.

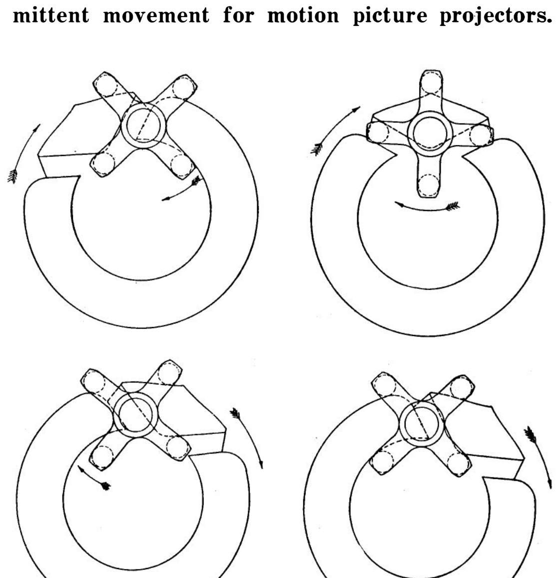


Fig. 5.—Successive positions of the parts in a complete movement of the Power intermittent motion.

## A Long Delayed Application

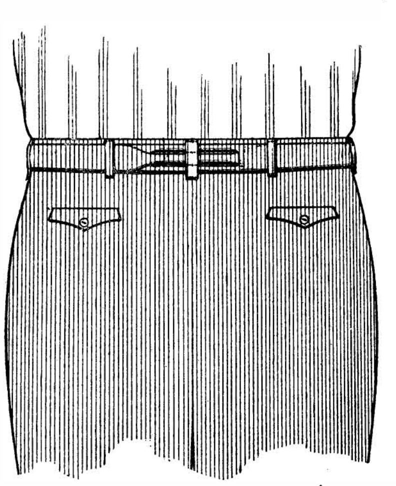
THE Court of Appeals of the District of Columbia has had under consideration an *ex-parte* Patent Appeal in which probably a record case of time in the Patent Office is involved. The patent application, the subject of this appeal, was filed in the Patent Office in 1880. As one of the counsel suggested at the argument, the application was in the Patent Office a period equal to or in excess of the succeeding terms of two patents, the patent term being seventeen years, while the application has been in the Patent Office more than thirty-four years. Incidentally, there was raised the bearing upon the application of an expired patent, the application for which was filed subsequent to that of the application in question. It does not appear that there could be an interference, and the extent to which the patent could be held a constructive notice to the applicant is subject for argument. The present Commissioner's endeavor has been to avoid the delays in applications, and during the argument of the appeal in question counsel asserted that there had been consumed 50 per cent more time by the Patent Office in acting on the merits than by the applicant in replying to the official objections, a rather unusual circumstance in delayed applications of this character.

## RECENTLY PATENTED INVENTIONS

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

### Pertaining to Apparel.

WAIST BELT.—L. RECHTSCHAFFEN, 441 E. 119th St., New York, N. Y. This invention provides a belt for use on trousers and other garments and arranged to enable the wearer to readily open and close the belt and to allow of adjusting the belt with a view to draw it more or less tight around the waist to suit the convenience of the wearer. The belt is made in sections and preferably of the same material as the garment.



WAIST BELT FOR TROUSERS, ETC.

### Pertaining to Aviation.

AEROPLANE BALANCE.—G. MEZZATESTA, 170 E. 61st St., New York, N. Y. This invention refers particularly to means for balancing the aeroplane automatically. It provides a structure which may be easily thrown into operation and out of operation, and when in operation to automatically maintain the aeroplane in the course being followed.

### Electrical Devices.

WIRELESS TRANSMISSION OF ELECTRIC ENERGY.—R. C. GALLETTI, 18 Cranley Place, London, S.W., England. The main object of this invention is to provide means for transmitting electric energy at a distance without connecting wires, and the inventor has found that such means permit the reception of signals at a distant receiving station directly by an indicating device without the interposition of a detector or its equivalent.

### Of Interest to Farmers.

MOWING MACHINE.—C. LORENSON, Box 138, Davenport, Iowa. This invention provides means for raising the finger-bar and knife-bar and maintaining them raised, horizontally or at an angle; means for taking up the drag of the finger-bar; means for avoiding side-draft; means for protecting the pitman from tall grass being bent thereover; means for directing grass away from the shoe carrying the finger-bar to the knife-bar; means for varying the speed by means of sprocket wheels of various sizes; and means for special work.

SANITARY ATTACHMENT FOR MILK PAILS.—J. T. WILLIAMS, 421 Navarro St., San Antonio, Texas. This attachment for milk pails prevents access of dust, dirt, or noxious germs to the milk during the milking operation. It comprises short open-end sleeves or tubes made of canvas or other suitable flexible material and provided with a lengthwise slit to receive the hand of the milker, and also with a finger loop for use in supporting the sleeve during milking.

CATTLE GUARD.—I. LAWRIE and D. F. BRAZEL, care of H. M. Layton, Box 16, Thaba Nchu, Orange Free State, S. Africa. This invention relates to cattle guards adapted to be placed between the rails of a railway track adjacent to a crossing, and at the outer sides of the rails, to detect cattle from taking the direction of the track. It provides a cattle guard having novel guard elements so supported as to have marked instability to the tread of the cattle.

MILKING MACHINE.—L. P. PATTERSON. Address W. B. Laroutte, Carthage, Mo. An object here is to provide a system for automatically milking a number of cows and delivering the milk to containers ready for shipment. Another, is to provide in a machine a pneumatically operable pulsator carrying teat cups and including means for providing an intermittent direct cut-off to the cups, whereby to periodically relax the teats.

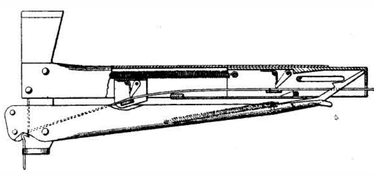
### Of General Interest.

EXPLOSIVE BARRIER.—G. E. ELIA, 16 Via Ludovisi, Rome, Italy. This invention provides an explosive boom for the defense of ports and similar purposes, and it has more particularly in view to insure the explosion of at least one of the boom elements on the boom being crossed by a running vessel, said explosion occurring, namely, if the vessel possesses a flaring bow (sliding vessel) which enables it to pass over the boom.

DEVICE USED IN THE FORMATION OF JETTIES.—E. E. EVERETT and D. F. SHELDON. Address Don G. Bowker, Attorney, Ventura, Cal. This invention relates to jetties for rivers or other flowing streams, and more particularly to an improved element or unit adapted to be used in the construction of the jetty. The principal object is to provide a device which may be used as an element or unit in forming a jetty, and which will overcome the disadvantages accruing to forms used in jetties and those of a similar nature.

### Hardware and Tools.

HAMMER.—V. T. LYNCH, 3826 North Racine Ave., Chicago, Ill. Mr. Lynch's invention relates to means for nailing objects together, such as laths, shingles, siding, etc., to suitable supports, covers on boxes, etc., and one of the main objects thereof is to provide an implement which automatically makes a nail and holds the same in position for driving. It provides means for feeding wire for the nails from a coil or the like; also for insuring the feeding of the same length of wire for each nail formed and driven.



HAMMER.

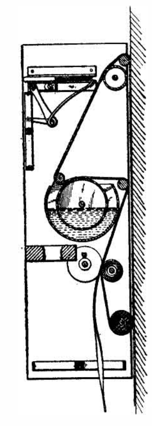
### Household Utilities.

TOILET APPLIANCE.—J. A. F. DANNER, 951a Elizabeth Ave., Elizabeth, N. J. The invention relates to mechanical means for using toilet paper in connection with water-closets, and provides such means which obviate the usual manual manipulation of such paper. It provides such means which are operable entirely from the exterior of the bowl of the closet.

FAUCET FILTER.—J. BOULARD, care Fred. Griffin, 25 Beaver St., New York, N. Y. This invention relates to a filtering device which is adapted to be used in connection with various types of faucets whereby water can be drawn off free from sediment and deleterious matter and at a comparatively fast rate.

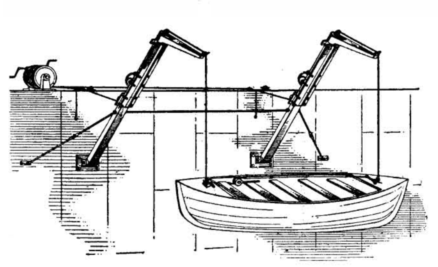
### Machines and Mechanical Devices.

PAPER HANGING DEVICE.—J. N. CAMPBELL, Linden, N. J. By use of this device paper may be placed directly on the wall or on the ceiling from the supply roll. The device is comparatively small so as to be readily operated by a workman and raised from the floor to the ceiling when placing paper on the wall, and readily moved across the ceiling when placing paper thereon, the same being formed so as to apply the paste to the paper as it is placed on the wall.



PAPER HANGING DEVICE.

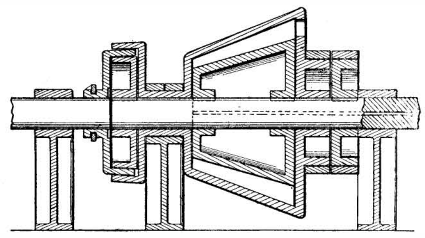
DEVICE FOR LAUNCHING LIFE BOATS.—R. W. LEEMING, Brantford, Canada. The object here is twofold—first to retain and improve the present method of launching by which the boat is let down close to the ship, a method which does fairly well on a smooth sea, but is dangerous in rough water, panic or other emergency. Secondly—by the same mechanism to launch the boat from fifteen to twenty feet away from the side of the ship. An improvement is effected even when launching close alongside, the old-fashioned davit blocks and ropes being replaced by a single cable from the winch to each davit. These cables are both wound on the same winch drum, which expedites lowering the boat and ensures its being let down on the level. But if the sea is rough, then with the same apparatus the boat may be swung out clear away from the side of the ship, as shown in the engraving.



DEVICE FOR LAUNCHING LIFE BOATS.

### Prime Movers and Their Accessories.

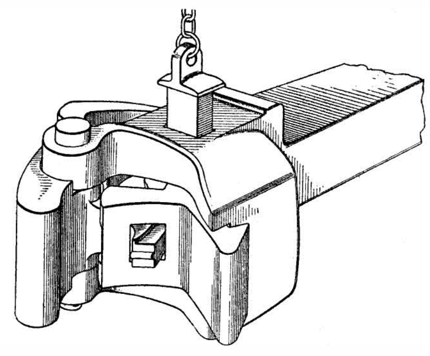
TURBINE.—G. W. CRAWFORD, Route 3, Fremont, Mich. The object in this case is to provide a device wherein the two elements of the turbine are mounted to rotate, and wherein other mechanism is provided for fixing either of the said elements, to make the said element the stator and the other the rotor, and wherein clutch mechanism is provided for permitting either of said elements to be connected to the driving shaft.



TURBINE.

### Railways and Their Accessories.

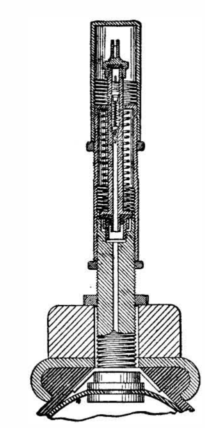
AUTOMATIC CAR COUPLING.—C. H. STARK, Room 924, Colorado Bld'g., Washington, D. C. The primary object in this invention is to provide a car coupling strictly in keeping with the present type or style known as the Janney type or Master Car Builders' coupler, but possessing new and improved characteristics, such as will eliminate the necessity of persons going between the cars for the purpose of opening the knuckle or placing any part of their body between the cars in order to adjust the knuckle or coupler head.



AUTOMATIC CAR COUPLING.

### Pertaining to Vehicles.

VALVE.—A. JAQUISH, Ontario, Ore. This invention has reference to air valves, such as used in pneumatic tires, and the main object thereof is to provide a valve which automatically prevents a blow-out due to too great pressure within the tire; and a further object is to provide means, in connection with such safety device, for determining the extreme pressure which it is desired to have within the tire.



PNEUMATIC TIRE VALVE.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

WE wish to call attention to the fact that we are in a position to render competent services in every branch of patent or trade-mark work. Our staff is composed of mechanical, electrical and chemical experts, thoroughly trained to prepare and prosecute all patent applications, irrespective of the complex nature of the subject matter involved, or of the specialized, technical, or scientific knowledge required therefor.

We also have associates throughout the world, who assist in the prosecution of patent and trade-mark applications filed in all countries foreign to the United States.

MUNN & CO.,
*Patent Solicitors,*
233 Broadway,
New York, N. Y.

Branch Office:
625 F Street, N. W.,
Washington, D. C.

### Running Railroads by Water Power

(*Concluded from page 603.*)

ever, from Avery, Idaho, to the Pacific Coast. The railroad would like to electrify that portion of its line, but the power sites necessary to this accomplishment are controlled by the Government. Therefore, we have, on the same line of railroad, an electrified section in which no exhaustible coal supply is used and in which certain water powers that would otherwise be wasted are being utilized. This is the section which the conservation policy of the Government has not been able to affect. Along the other section, where the Government is all-powerful, the railroad is wasting enormous quantities of coal and the patrons of the road are being obliged to pay higher rates for transportation service than they otherwise would.

Of course, electrification by water power development is not possible over all railroads in the United States, but it is possible over the greater part of them. A supposedly righteous Government is regulating the railroads to the point of bankruptcy. A supposedly righteous people is demanding still lower rates and higher wages. Yet this supposedly righteous combination of Government and people has, by law, forbidden the railroads from accomplishing a very considerable part of the results which the combination demands.

### Research and Industry

WITHIN the past few weeks two very instructive contributions have appeared on the importance of chemistry and chemical research to the industries to which chemistry may be applied. One of these contributions is a symposium of papers read before the New York section of the American Chemical Society and published in the industrial *Journal* of that society.

The second is a paper by Prof. P. F. Frankland before the Birmingham section of the Society of Chemical Industry. The American papers show great enthusiasm over advances made. The English papers show discouragement and almost despair on account of lack of cooperation between those who might benefit by it.

Hitherto such papers have been written by chemists or men actually engaged in research. In this instance the papers come from business men who have profited by research. Hence, they are to be regarded not as a pean of self-praise, but as dispassionate opinions on the business value of research. A number of the industries discussed are very old—so old that they go back to a time before chemistry became a science, being even then so well developed by experience that they were thoroughgoing industries. Under this head may be put the copper, cement and glass industries in the inorganic field, and the wine, sugar, textile, leather, brewing and paper industries in the organic field.

But, in spite of this, representatives of all these ancient industries gratefully acknowledge their indebtedness to the chemical research which has added to the knowledge and skill in working and definiteness of control, which has so much increased the profitableness of their industries and the satisfaction which they have in conducting them.

Other industries have been founded in comparatively recent years entirely as a result of chemical research. Among these the corn products, asphalt, cottonseed oil and celluloid industries, the fertilizer, soda and incandescent mantle industries are especially notable. Not only have these industries been founded on chemistry, but since their establishment persistent chemical research has improved the methods of manufacture and control, cheapening the product as well as maintaining a favorable balance for the manufacturer.

A large number of the industries contributing to the symposium are not what would strictly be called chemical industries. Their products are not chemical compounds, and while the processes used involve chemical changes, they are in

many cases so confused and obscure that they would drive the systematic chemist to despair. That chemists have been able to be of aid even here is most encouraging, and that the executive officers of these industries should be willing to testify to the aid received is even more encouraging as evidence that a helpful co-operation is prevalent and is to be maintained. Part of the chemical work to which the industries are indebted is that which they have inherited from an older period or have borrowed from foreign research or foreign practice; but it is also true that a large part of this indebtedness is due to research by American chemists employed directly by the industries concerned.

Some of the results recorded are indeed almost miraculous. A very small quantity of arsenic in copper greatly lowers its conductivity; a quarter of 1 per cent cuts down its conductivity from 101 to 45. Refined copper for this purpose should contain less than one one-thousandth of 1 per cent of arsenic in order to satisfy the consumer. The chemists have made such results possible by their able research work and also by their remarkable improvements in analytical methods.

Glucose is the cheapest food-fuel known. Grape sugar or corn sugar also is an important product and is manufactured in a variety of grades. Due to the great care which the chemist exercises in devising ways and means of controlling the process of manufacture in all of its details, the quality of the articles produced is of such excellence as to have secured for this country by far the largest portion of the world's trade in these commodities.

While the chemist has worked to improve the manufacturing side of the cottonseed oil industry, he has been the means of putting something like $125,000,000 every year in the hands of farmers; or, in other words, he has added ten or twelve dollars to the crop for every bale of cotton grown and has made possible an industry which provides means of livelihood for thousands of people in hundreds of factories and on the road selling the products.

Beginning with a trifling manufacture forty years ago, the cement industry, after fighting against difficulties in manufacture and against peculiar marketing prejudices, now produces 125,000,000 barrels of cement per year. This advance is nearly all due to the work of chemists, who first proved that we have suitable material, and then that we can use these materials in making really superior cement, devising apparatus and working out methods of control, and especially showing users of cement how to get the best results in their work.

All through the development of the sugar industry the chemists' work has been of assistance in so many ways that they cannot even be summarized.

After solving the very fundamental principles of the manufacture of incandescent mantles, in the further development of industry "the mantle manufacturer has held before himself for many years certain ideals toward which he has earnestly striven. Among these may be mentioned strength with elasticity, high and maintained candle power, preservation of color, and absence of shrinkage. A realization of these ideals seems finally to have been met in the mantles made from the bundles of homogeneous, elastic, spring-like fiber known as artificial silk."

The textile industry is aided by the chemist all through, in bleaching, in dyeing, and in producing dyes. Artificial silk, now widely used, is an entirely chemical product.

As to the flour industry: "Chemistry assists in selecting and buying the grain; it helps to show the quality of the flour produced. It has supplemented mechanical processes of the mill and accomplished what had long been desired but could not be attained, in the improvement of color and baking qualities of the flour. By the introduction of baking powder products it has made possible many delicacies in the way of pastry and biscuit and has made possible the great self-rising flour industry. It has helped to

explain the intricate process of the fermentation of bread dough, has pointed out the way to fit flour for it, and has unlocked doors for investigating problems of bread production, which have, as yet, opened only enough to permit a glimpse of a large space filled with interesting and useful possibilities."

The pyroxylin industry, which produces celluloid, collodion, guncotton, smokeless powder of certain kinds, artificial silk, and picture films is wholly due to chemistry, and as a result "there is not a factory of pyroxylin compounds of any importance in existence to-day that has not its busy staff of analytical, managing and research chemists."

Soon after the beginning of modern chemistry work was begun to improve the ancient industry of glassmaking. These studies have been made by German and French chemists in the main until rather recently when American investigators have also entered the field and made advances. The chemical researches made on glass have been especially systematic and have been directed to leaving the connection between the composition of glass and the various mechanical and physical peculiarities which fit each kind of glass for its intended use.

The great desirability of co-operation between manufacturers and chemists is very strongly expressed in the address of Prof. Frankland on the "Chemical Industries of Germany." After recounting at length and with high appreciation the story of cordial co-operation of manufacturers, chemists and the government in the development of those industries, he goes on to speak of the contracting condition in England in words which deserve to be quoted as a warning:

"The facts which I have brought forward speak for themselves and proclaim in the most convincing manner the stupendous progress which has been made by Germany in the chemical industries during the past forty years. It is equally certain that England, once pre-eminent for chemical manufacture, has not progressed at the same rate, and is at the present moment suffering much inconvenience through being so largely dependent on German chemical products of one kind and another. The country is now reaping the harvest of humiliation which it has sown for itself in spite of the warnings repeated *ad nauseam* by the chemical profession during a whole generation. The systematic neglect of chemical science and the failure by manufacturers to utilize the services of highly qualified chemists could only lead to the result that all the industries which are dependent on a profound knowledge of chemistry should tend to disappear from our midst and pass into the hands of those who are prepared, not only to apply new chemical discoveries to industry, but even to prosecute the most varied chemical investigations in the hope of sooner or later making discoveries which shall be of advantage to their commercial undertakings.

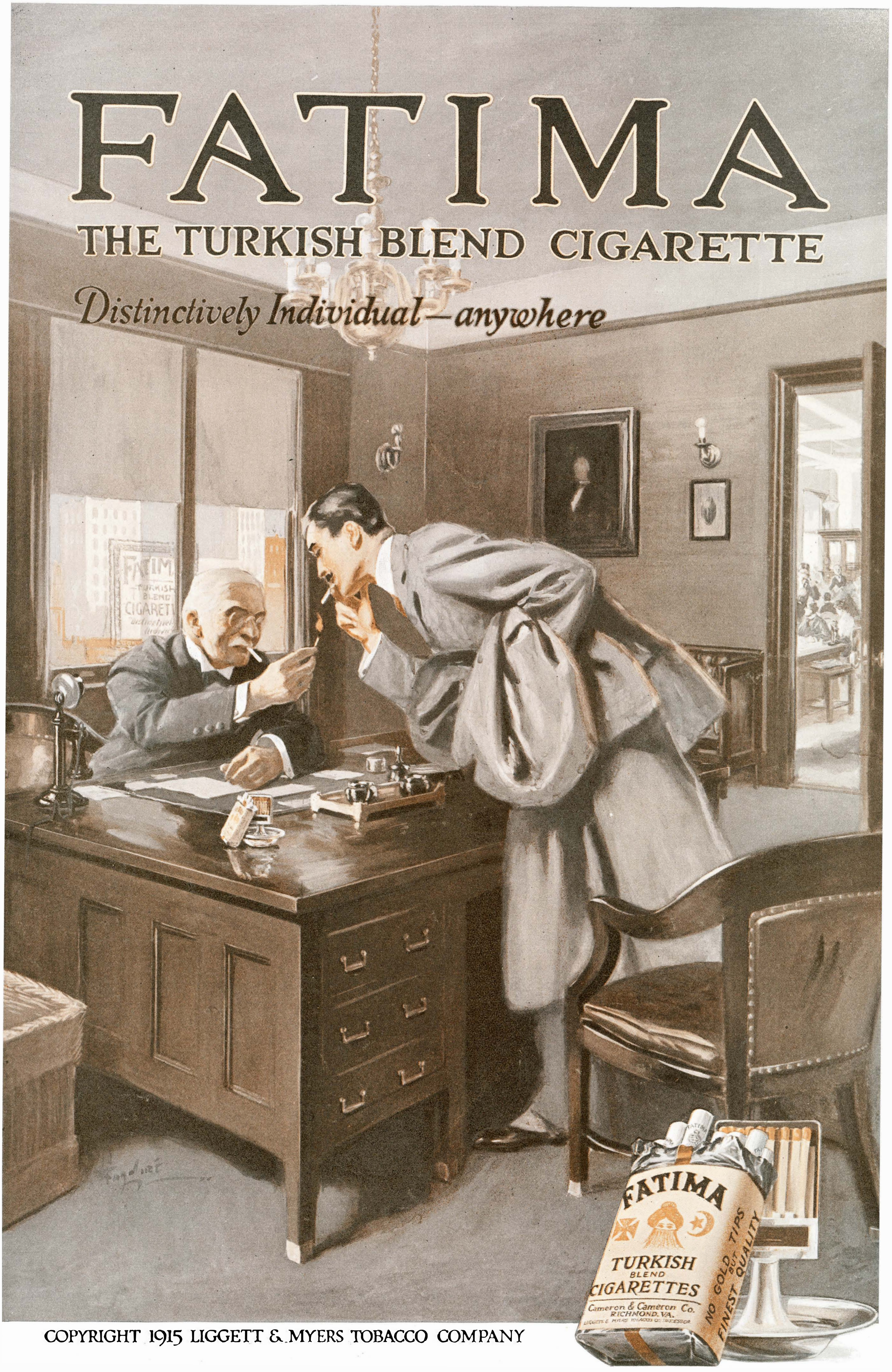
"The complete breakdown in our supply of fine chemicals, which is the direct outcome of the disregard of the constant warnings emitted by scores of British chemists, has led the government of the day to intervene and attempt to remedy the intolerable state of affairs which has arisen in connection with the supply of coal-tar colors.

"It will certainly be necessary that expert chemical knowledge should in the future be much more highly remunerated than it has been in the past, otherwise the supply of able and properly qualified men will not be forthcoming. The flow of men of high-grade intelligence into a profession is determined by the prizes which the profession has to offer, in the form of money and social position.

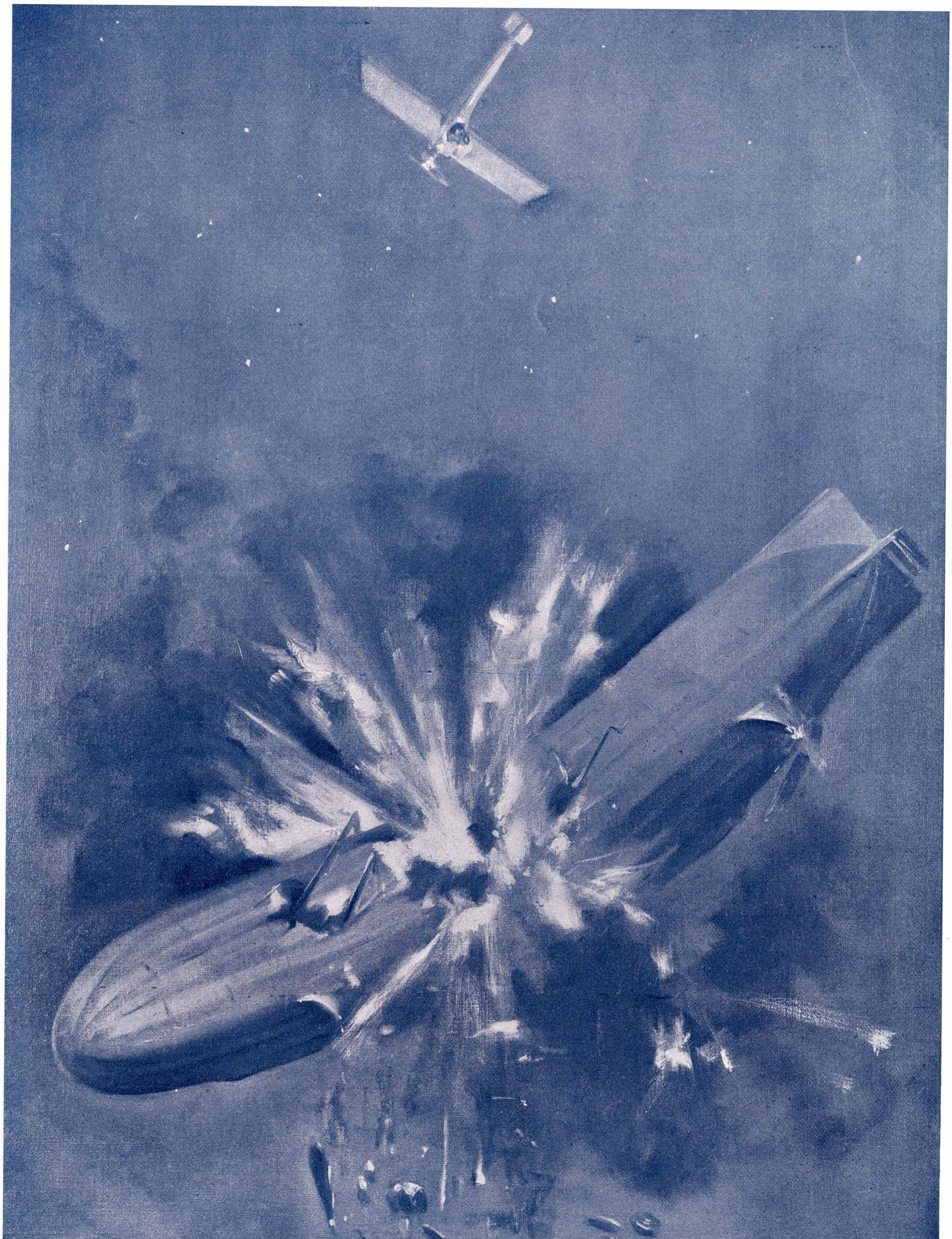
"If there is to be a large influx of high intelligence into the chemical profession, it will be necessary that there should be some very different prizes from the paltry bait which is offered at the present time, for the study of chemistry in this country now only draws those men who either have or think they have an overpowering zeal and passion for the science, to which they devote themselves against the advice of their friends, and in spite of the warnings of the professors of chemistry by whom they are initiated. Notwithstanding the absence of material inducements, I venture to say without fear of contradiction that there is more original investigation being prosecuted in this country by chemists than by any other body of British men of science, and this I attribute to the fact that such a large proportion of our number have either been at German universities or are the pupils of those who have been at these centers of research. Nor are any of us, I am sure, even during this unfortunate crisis, unmindful of the hospitality and the inspiration which we have received in the schools of the enemy. If the proposed undertaking is to succeed, real chemists must be on the directorate, and in a sufficient proportion to give effect to their views. Many men of science are excellent business men."


Cork Tip
or Plain End
15¢
MOGUL
EGYPTIAN
CIGARETTES
"JUST LIKE BEING IN CAIRO"
Anargyros A CORPORATION
Makers of the Highest Grade Turkish
and Egyptian Cigarettes in the World


GOOD NEWS for all Friends and
Admirers of Egyptian Plain End Cigarettes
MOGUL
EGYPTIAN
CIGARETTES
the most delectable of all Mild
cigarettes may now be had
PLAIN END
In the convenient FLAT BOX
with the PROTECTIVE INNER
FOIL and OUTER LINEN
WRAPPER.
15¢
MOGUL
EGYPTIAN
CIGARETTES
Anargyros
A CORPORATION
SELECTED
TURKISH
TOBACCO
Anargyros A CORPORATION
Makers of the Highest Grade Turkish
and Egyptian Cigarettes in the World.


FATIMA
THE TURKISH BLEND CIGARETTE
Distinctively Individual—anywhere
FATIMA
TURKISH BLEND CIGARETTES
Cameron & Cameron Co. RICHMOND, VA.
NO GOLD TIPS BUT FINEST QUALITY
COPYRIGHT 1915 LIGGETT & MYERS TOBACCO COMPANY

# Scientific American

DESTRUCTION OF A ZEPPELIN BY A BRITISH MONOPLANE—[See page 627]


Vol. CXII. No. 26
June 26, 1915

Munn & Co., Inc., Publishers
New York, N. Y.

Price 10 Cents
$3.00 A Year

SEVENTY-FIRST YEAR

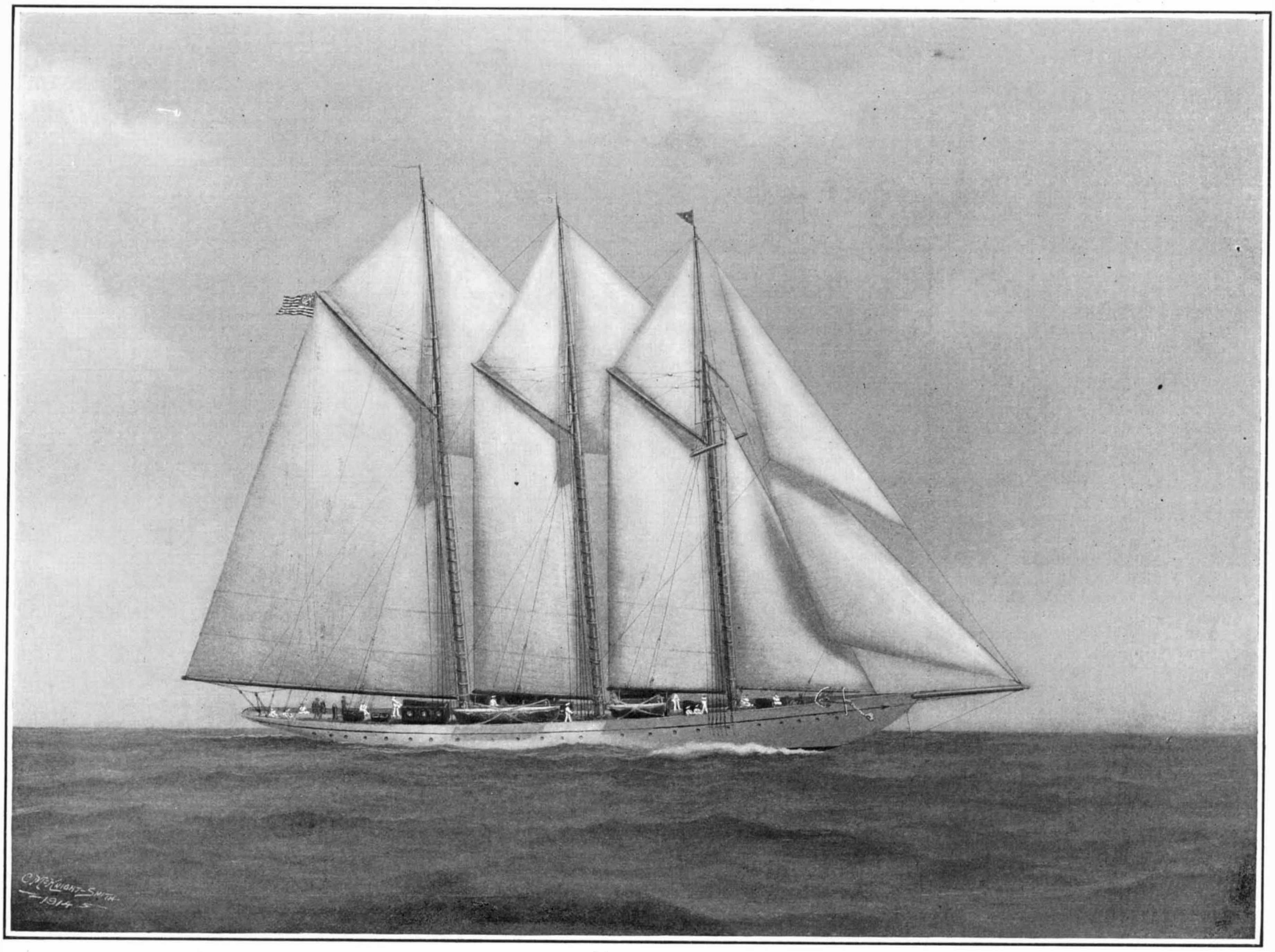
SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

VOLUME CXII. NUMBER 26.

NEW YORK, JUNE 26, 1915

10 CENTS A COPY $3.00 A YEAR



**Length on deck,** 214 feet. **Length on water-line,** 150 feet. **Beam,** 33 feet 6 inches. **Draught,** 18 feet. **Height water to truck of mizzen mast,** 167 feet. **Auxiliary motor,** 400 horse-power kerosene.

**The "Sea Call"—largest fore-and-aft schooner yacht afloat.**

## The Three-masted Auxiliary Schooner Yacht "Sea Call"

THE auxiliary three-masted schooner yacht "Sea Call," recently launched at Lawley's yard, and now being completed for deep-sea cruising, is the latest and largest of the three-masted fore-and-aft schooner yachts of which several have been built in this country.

She has been built for Alexander S. Cochran, who is also the owner of "Vanitie," built last year for the defense of the America's Cup. Although she has been constructed primarily as a deep-sea cruiser, the size of the yacht, her refined model and her powerful sail plan, will probably render her the fastest sailing yacht afloat. If she should engage in racing during the present season, her ablest competitor, provided her owner places the boat in commission, would be the "Atlantic," the famous winner of the transatlantic race for the cup offered by the German Emperor. "Atlantic," also a three-masted auxiliary, was designed by William Gardner of this city, from whose draughting board also has come the "Sea Call."

The principal dimensions of the "Sea Call" are: Length over all, 214 feet; length on load waterline, 150 feet; beam, 33 feet 6 inches; and draft, 18 feet. Built for ocean cruising she is equipped with a complete seagoing rig, including square sail on foremast, three head sails forward, a short mizzen boom and gaff for offshore work.

The bottom of the hull is built of Monel metal which will be polished and not painted; the topsides and the framing are of a special steel made for this yacht. The frames are bulb angles, and the yacht has five steel bulkheads and seven deep web frames, which together will give great transverse strength to the hull. The deck beams are of channel steel and the yacht has been built under special survey by Lloyd and is classed 100-A.

On deck are two large Monel metal deckhouses for the use of the owner and guests, one between the main mast and the mizzen and the other just aft of the mizzen mast. The owner's accommodations consist of a large salon, 16 feet long by 31 feet wide, four large guest rooms, with two baths, and the owner's room with bath and also a large owner's storeroom. The owner's room is aft of the accommodations, and aft of this is a large chart room with lockers for stowing sails.

Below decks the finish of the yacht is simple, being entirely in white. The steering gear consists of a diamond screw gear placed below the deck. This is operated by a shaft from a stand on deck, which is equipped with two wheels, one on the fore and one on the after side of the stand. All the bearings of the steering gear consist of balls or rollers.

The three masts are of nickel steel and the rest of the spars are of hollow wood. Some idea of the enormous rig will be gathered from the fact that the distance from the water-line to the top of the mizzen truck is 167 feet. Because of the long overhang forward, the jib stay will set up on the stemhead. Since the boom extends but little over the taffrail, the sail, despite its great area, will be practically inboard in bad weather.

The motive power consists of an eight-cylinder gasoline or kerosene engine, developing 400 horse-power, at 250 revolutions per minute. The cylinders are 12½ inches in diameter by 20 inches stroke, and they drive a two-bladed feathering propeller of the Bevis type, seven feet six inches in diameter. There will be one 20-kilowatt General Electric dynamo set, one combination dynamo air and bilge pump, and one electrically driven ice machine. The hoisting of the anchor and the sails will be done by a bronze, electrically driven windlass, and there will be another electrically driven windlass on the after-deck. As will be seen from our engraving, the "Sea Call" possesses the characteristic beauty of line which marks the Gardner yachts.

## New Uses for Infusorial Earth

OUR 6,500 tons of infusorial earth mined in Nevada and California is finding a ready market at $10.50 a ton. It has long been used in polishing powders and soaps and to absorb nitroglycerine forming dynamite and as a heat-insulating material in packing safes, steam pipes, etc., but now talking machine records are to be made from a boiled mixture of the earth and shellac. In Europe it is used to absorb liquid bromine, which they then put on the market as "solidified bromine," and especially to absorb liquid manures for more convenient handling.

# SCIENTIFIC AMERICAN

**Founded 1845**

**NEW YORK, SATURDAY, JUNE 26, 1915**

Published by Munn & Co., Incorporated. Charles Allen Munn, President; Frederick Converse Beach, Secretary;
Orson D. Munn, Treasurer;
all at 233 Broadway, New York.

Entered at the Post Office of New York, N. Y., as Second Class Matter
Entered as Second Class Matter at the Post Office Department, Canada.

Trade Mark Registered in the United States Patent Office





**Subscription Rates**

| | |
|---|---|
| Subscription one year.......................................... | $3.00 |
| Postage prepaid in United States and possessions, Mexico, Cuba, and Panama. | |
| Subscriptions for Foreign Countries, one year, postage prepaid, | 4.50 |
| Subscriptions for Canada, one year, postage prepaid.......... | 3.75 |

**The Scientific American Publications**

| | |
|---|---|
| Scientific American (established 1845)...............per year | $3.00 |
| Scientific American Supplement (established 1876).... " " | 5.00 |
| American Homes and Gardens........................ " " | 3.00 |

The combined subscription rates and rates to foreign countries including Canada, will be furnished upon application.

Remit by postal or express money order, bank draft or check.

**Munn & Co., Inc., 233 Broadway, New York**

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp* the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.


*The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.*

## A Great National Movement

IF the present Administration at Washington is desirous of keeping in close touch with the trend of public opinion on matters of national importance, it will do well to take note of the full significance of the remarkable series of public meetings which were held in New York during the past week under the auspices of the National Security League. No thoughtful observer could fail to have been impressed with the serious purpose, the earnest zeal, and the unanimity of opinion both of the distinguished speakers at the various meetings and of the large audiences which gathered to hear them. Also it takes but a glance at the list of officers and speakers and members of the League to realize that here we have represented all shades of political opinion—clear evidence of the fact that this movement is one of those whose springs lie deep in a consciousness of the fact that an issue of the gravest national importance is involved.

It is most unfortunate (and we speak here from direct personal knowledge and intercourse) that some of the leading members of the Government are making the same mistake of which they were guilty in regard to that other great non-political body, the Navy League. These officials have not hesitated to state in the most emphatic terms that the present movement for strengthening our national defenses is a purely political movement, aimed at weakening the influence of the present Administration.

Now, we have every reason to believe that nothing could be further from the truth. In the first place, it is only necessary to consider the list of the men who are prominent in this movement to see that it includes distinguished names from both the great political parties; and, furthermore, both in the literature put forth by these various movements for defense and in the public speeches of their accredited representatives, there is a remarkable absence of any evidence that the movement is political, and there is every evidence that its controlling motive is a patriotic desire to further the highest national interests of the country, irrespective of party or creed.

It may be laid down as a principle which cannot successfully be contradicted that there are some matters relating to the highest welfare of a nation, which are of such vital importance that they should be lifted far above the level of party strife and be safeguarded against the chances and accidents to which any mere party measure is inevitably exposed. Ranking high among these, surely, is the question of the security of a people and their country against invasion by a foreign power and the imposition upon them of the masterful will of a conqueror.

This, indeed, should form one of the very first, if not, indeed, the first object of government; and if the Administration fails to make every reasonable provision thus to safeguard the country against foreign attack, it is guilty of a very grave dereliction of its highest duty.

The existence and rapid development of the present popular movement to impress upon Congress the need for making considerable additions to our naval and military forces presents one of the most anomalous conditions that have ever occurred in the history of this Republic; for here we witness an attempt, on a very large and widespread scale, of the people to provide themselves with those defenses and to organize themselves for those military contingencies which should properly be the object of the earnest and active solicitude of their Government; but which, as matters now stand, the Government refuses to take any action upon or even earnestly to consider.

But the case is even more serious than that; for not only has the Administration refused to countenance this popular movement to find out the actual truth, but it has put itself in a position of active obstruction by placing a padlock upon the lips of every officer of the naval and military service. It has condemned them to silence, giving as a reason the desire of the Government to prevent these gentlemen from saying anything which might violate the absolute neutrality of the United States during the present war—as though, forsooth, the enlightenment of the people of this country as to the condition of their defenses could, by any stretch of the imagination, be construed as an act hostile to any of the belligerents in far-distant Europe.

## Learning Through Doing

WITH the beginning of the new school term in February, some of the public high schools in New York city entered upon a radical experiment in education. In the usual manner of the metropolis, this experiment was entered upon after having been tried out in other parts of the country. But it will also be tried on a more comprehensive scale than has ever been used before.

The plan in question is the so-called "Cincinnati Plan," first organized at the Unversity of Cincinnati School of Engineering by Dean Herman Schneider; and it has several features that are of significance to the world of practical affairs.

In the first place it means that the educators have recognized certain limitations of the school room. From the assumption that "teaching" can impart all that youth needs to learn they have come to a lively realization of the fact that we can learn to do only through practice in doing. It is nearly three hundred years since Comenius laid down the maxim that children must learn to do by doing; and it is forty years since manual training was introduced into public schools in this country. But the schools, with all their devices, have not been training for the economic life of the day for the simple reason that the school can never duplicate industrial conditions. Once this fact is frankly accepted, the next step is plain.

The second point is that if young people are to learn to do things as they are being done in business, the shop and the office and the store are the right places for learning. This means that the students are to spend part of their time in industrial activities, and part of their time in school; for there is still much for the school to do. In the present plan, the high school pupils will spend alternate weeks in school and in the shops or offices.

Some inconvenience may be involved for the foreman or superintendent; but this is justified, for the plan makes the assumption that industry must share the responsibility for the training of its workers. With the decline of the apprenticeship system the training of artisans has become in many industries a haphazard drifting. In the course of time the managers of these industries have come to depend upon their competitors and the "public" to provide trained and experienced workers. The competitors shared in the waiting, and the public had not learned how to provide the workers, with the result that skill declined while the young people grew up without training.

A fourth point in the plan is the idea that certain large social problems—and education of the next generation is one of the largest—cannot be solved by any single agency, but must be attacked by two or more agencies co-operating to a common end. It is certainly significant that busy men of affairs, who have in the past asked only to be let alone, and the equally busy men of the schools, who have in the past asked only for a chance to mind their own business, can come together in the interests of the community's welfare and co-operate on a basis that is entirely strange to both of them.

It is interesting to note that this plan appeals at first only to those who have been accustomed to dealing with the larger problems of business policy and administration. The chief clerks and division managers who have reached the limits of their development are quick to reject the plan—because it is so different from what they are used to, because they have not the imagination to see its possibilities, because they are too much obsessed by their own routine. And the same thing may be said of the school men; the routineers are wedded to their routine.

The co-operative plan means getting away from routine in every way. The students will have work assigned to them according to carefully prepared syllabuses, with the purpose of allowing each one to learn the relation of the various processes to one another, and not merely to acquire skill at some specialized process. The work is to be progressive in the shop or office, just as it is planned to have the work progressive in school. On the other hand, the progress in the school is not to proceed along the insulated path of the old-style school: the school work is to be closely correlated to the practical work, through the activities of "co-ordinators"—specialists assigned to keep in constant touch with the students at their work and with their teachers at school. Moreover, the work is to be flexible enough to permit constant readjustment of the syllabus in the school as well as in the shop, as conditions may indicate new needs.

This plan has already demonstrated its workableness in several high schools throughout the country, and will undoubtedly lead to greater school efficiency as well as to greater economic efficiency. If it does no more than start the teachers and the employers along the path of experimentation and imbue them with the spirit of co-operation, it will justify itself in a very short time. But it will do much more both for education and for industry.

This is a radical departure from the methods of training used in the medical and legal professions, although it embodies the same fundamental principles. The success of the experiment in New York will accelerate the development of vocational education for the country.

## Weather Influences on Mankind

WEATHER influences on man may be roughly divided into two classes; viz., (1) those which are direct and obvious, and (2) those which are more or less indirect and obscure. The influences belonging to class (2) have been, during the past decade or so, the subject of immense research.

Some persons are pronounced "meteoropaths"—abnormally subject to "weather neuroses." Friedrich Nietzsche was one *par excellence*. Such persons as a rule are, more specifically, "cyclonopaths." The passage of cyclonic depressions, accompanied by certain characteristic types of weather, is reflected in their sensations and in the mode of operation of their bodily and mental functions. The gross change of barometric pressure pertaining to a cyclone, or "low," is not, in itself, an important factor in producing these manifestations, since it never exceeds that experienced in the ascent (without the effort of climbing) of a good-sized hill; indeed, many "lows" do not expose us to greater pressure changes in the course of twenty-four hours than we experience in a couple of minutes in riding to the top of an average office building. On the other hand, there are rapid, ripple-like fluctuations of pressure, revealed by the microbarograph and especially by the variograph, to which some people seem quite sensitive. The pathological effects of certain winds—e. g., the Swiss foehn—have been attributed to these minute fluctuations of pressure.

Again, the low pressure of a cyclone is said to favor the emission of radioactive emanations from the ground; atmospheric ionization is increased; the air becomes a better conductor of electricity; and the electrical charge of the human body is carried away at a more rapid rate than usual. This process, according to Escales and others, has a pathological effect in nervous subjects. We state the hypothesis for what it may be worth.

Solar radiation unquestionably affects mankind in ways other than those we recognize as ordinary light and heat effects. Such observations as those of Dorno, at Davos, show quite different annual curves for the different kinds of solar radiation contained in sunshine; and these observations suggest a reason for the very different effects upon human feelings and activities of spring and autumn, essentially the same temperature.

We have only grazed the vast subject of weather influences. We pause at this point to answer the question which many readers will be asking: Where have the students of these problems recorded the results of their investigations?

Certainly not to a great extent in Anglo-American medical and physiological literature. We have, indeed, many books and memoirs in English on the general subject of medical climatology, and on many topics of a kindred nature; but the information they contain is (speaking in general terms) about a generation behind that available to persons who read German.

There now lies before the writer a work published at Wiesbaden last year by Dr. B. Berliner, "Der Einfluss von Klima, Wetter und Jahreszeit auf das Nerven- und Seelenleben," which is representative of a very large recent German literature. To American students who do not read the *Zeitschrift für Balneologie, Klimatologie und Kurort-Hygiene;* who are not familiar with W. Schmidt's variograph studies nor with C. Dorno's remarkable investigations of mountain light and air; who know nothing of the work of such men as Hellpach, Frankenhäuser, Dove, Lehmann and Pedersen (the last two Danes who write in German), and the other leading recent Germanic exponents of climatophysiology and climatopsychology; to such persons the perusal of Berliner's work can be recommended for meditation.

## Notes on the War

**German High Fleet in the North Sea.**—The repeated rumors that the German battleships have been out in the North Sea, that a column of such ships has been sighted by trading vessels, and that the sound of the firing of heavy batteries has been heard, are possibly correct. Because of the submarine menace, the British blockade is not a close blockade off Wilhelmshaven and the mouth of the Elbe—it does not need to be. The German battleships at Wilhelmshaven require target practice, and it is possible for them to go out into the North Sea for this purpose. The German Zeppelins would be able to tell them when the coast was sufficiently clear for such exercises.

**"Goliath" Sunk by a Turkish Destroyer.**—Before the war the Turkish navy had come to be considered to be a practically negligible quantity, ill-manned, inefficient, and composed mainly of obsolete ships. Hence the recent torpedoing of the battleship "Goliath" by a Turkish destroyer has come with shock of surprise. It was believed that the rapid-fire guns of a battleship would pour such a hail of explosive projectiles against an onrushing destroyer, that it could never get within accurate shooting range. But the thing has been done and a battleship of the earliest pre-dreadnought type is on the bottom as the result. What with batteries with direct and indirect fire ashore, drifting mines, submarines and destroyers, the Allied ships in the Dardanelles are certainly having a lively time of it.

**No Tents in German Armies.**—It may or may not have been noticed by our readers that in the photographs of the theater of war, at least on the German side, no tents appear. That is one of the innovations which modern warfare has brought in the German army. Tentage used to form a not inconsiderable part of the impedimenta of armies, and this elimination lightens not a little the task of the quartermaster's department. The German plans contemplate always an offensive, presumably to be carried out in the enemy's country, and involve the billeting of the troops in the homes of the inhabitants of the conquered country.

**Building Destroyers and Submarines at Antwerp.**—Our contemporary, *The Navy and Army*, is inclined to believe that the two torpedo boats recently sunk off the Dutch coast by the British Navy, were built in Antwerp and came out from that port—this belief being based on the fact that it would be impossible for them to have come from Heligoland or Wilhelmshaven or even Emden, because the intervening waters are too well patrolled. Although Antwerp is in Belgium, warships constructed there would have to pass through Dutch territory by way of the Scheldt, to reach the North Sea. That would be a breach of neutrality; but the Germans evidently would not consider this an insuperable difficulty. The Belgian coast and the French coast up to Havre are greatly coveted by Germany, because of their nearness to the British south coast, and the control they would give of the English Channel.

**German Submarine Losses.**—Every naval officer who has had experience in submarine service is satisfied that the losses in the German submarine fleet during the war must have been very large, and this in spite of the fact that their submarine service is probably highly efficient. The British state that the Germans have lost from a dozen to eighteen submarines. The number lost by capture or foundering must by this time come pretty well up to the dozen mark. It is known, that the Admiralty has used every possible device to sink or catch these craft. Netting has played an important part and has scored, if we are to believe reports, some four or five successes. The practice is to stretch a great length of steel wire netting, suspended from floats on the surface, in other words, to spread a huge seine net, such as fishermen use for shoals of fish. When submerged, the submarine is absolutely blind, and if it runs into one of these extremely strong and tough nets, the propeller is likely to become entangled, while the disturbance of the surface floats reveals its presence and brings the dreaded destroyers to the spot.

**Italian Heavy Field Artillery.**—Evidently the Italian government has laid to heart the lessons of the German invasion of Belgium and France, at least so far as the question of heavy artillery is concerned. The present operations in the mountain passes leading into Italy from Austria are mainly artillery engagements for the destruction of carefully prepared permanent fortifications, and the capture of the passes by the Italian troops. Italy has prepared for this very kind of warfare, and she is undoubtedly well equipped with just the kind of howitzers needed for the reduction of the fortresses. Notable among these is a very effective 12-inch howitzer, a new piece which has given great satisfaction to the Italian government. That effective work is being done is shown by the remarkable ease with which the forts crowning the mountain tops and guarding the passes have been battered into helplessness and taken by the Italian troops. The Italians have ever been skilled engineers, and not for nothing have they learned the lesson of Liège, Namur, Maubeuge and other permanent fortifications reduced by the Germans early in the war.

## Science

**A Climatological Atlas of the British Isles** in two quarto volumes, is to be published by the Royal Meteorological Society in collaboration with the British Meteorological Office. Details as to its contents are given in the last number of the *Quarterly Journal* of the above-mentioned society. The "normals" will be based mainly on the observations of the forty-year period 1871-1910, but monthly means will be given for each year from several stations having long unbroken records, such as London, 1774-1910. It is interesting to learn that the data of barometric pressure will be given in the new units, millibars, as well as inches. Heretofore only two countries have issued climatological atlases of so elaborate a character as the one proposed for the British Isles; viz, Russia and India. The forthcoming Agricultural Atlas of the United States will probably contain the largest collection of climatic charts ever issued for this country.

**The Rio Theodoro.**—An accurate map of the famous river explored by the Roosevelt-Rondon expedition in Brazil, prepared from the compass traverse of Lieutenants J. S. Lyra and Pyrineos de Sousa, the two Brazilian army officers who had charge of the survey work of the expedition, has at last been published in the *Geographical Journal*, and also appears, on a smaller scale and in one sheet, in the *Bulletin* of the American Geographical Society for May. This river has been many-named. Its lower course was formerly known to the rubber men as the Ariquana. While the river as a whole was still in the speculative stage it was called the Rio da Dúvida (River of Doubt). In the course of the recent expedition Colonel Rondon, acting on authority received from the Brazilian government before his departure, named it the Rio Roosevelt, but subsequently this was changed by the government to Rio Theodoro, which is an easier name for Brazilians to pronounce. The Spanish form, Rio Téodoro, which appears on some of the maps in Mr. Roosevelt's book and in other publications, is erroneous.

**European Weather Reports** have been generally curtailed or suppressed altogether during the present war. Apart from the fact that forecasters have been hampered by the suspension of telegraphic communication between mutually hostile countries, the fear of publishing meteorological information that might be useful to the enemy has led to the practice of delaying the issue of weather maps and bulletins until they have lost all value for practical purposes. Thus the French daily weather map is issued a week after the date to which it refers. Since the first of May the British Meteorological Office has ceased to issue any forecasts except those relating to spells of fine weather, which are telegraphed to agriculturists at the expense of the latter and are known as harvest weather forecasts. No forecasts are now issued to the newspapers. At the beginning of the war the newspaper weather charts were discontinued, and some months ago all references to the movements of barometric depressions and to winds were eliminated from the daily weather forecasts. All of which is a sad contrast to the hopes which were entertained of introducing great improvements in the European weather maps and reports in the year 1915, in accordance with a plan for uniform hours of observation and other reforms, proposed a couple of years ago by the director of the Russian meteorological service.

**Death Camas Poisoning.**—According to a bulletin recently published by the Department of Agriculture, one of the most serious sources of loss to sheep owners in the Western States, especially Wyoming and Montana, is *Zygadenus* (of several species) or death camas; also known under various other popular names, including such preposterous misnomers as "lobelia," "wild onion," and "water lily." Strange to say, a great many sheep owners do not know the plant, and ascribe the poisoning it produces to other causes. Thus lupines have been blamed for many cases of *Zygadenus* poisoning. It is said that in 1909 about 20,000 sheep were killed by this plant in a single county of Wyoming. Other animals seem less susceptible to its effects, though horses, cattle and human beings are made ill by it, sometimes with fatal results. Coville has reported that one species is sometimes used by medicine men of the Klamath Indians, mixed with the dried root of *iris missouriensis* and a little tobacco, to give a person a severe nausea, in order to secure a heavy fee for making him well again. The authors of the bulletin above mentioned report the results of elaborate experimental studies of this plant, extending over a period of five years. They are able to present a much more extensive account of the symptoms produced by the plant than has hitherto been available. Every effort was made to find some effective remedial treatment but without satisfactory results. Frequent doses of tannic acid or sodium bicarbonate aid in recovery, but the expense of such treatment is prohibitive, except when the animals are especially valuable. The only method of reducing losses appears to be to make the plant better known to shepherds, so that they will keep the animals away from it.

## Automobile

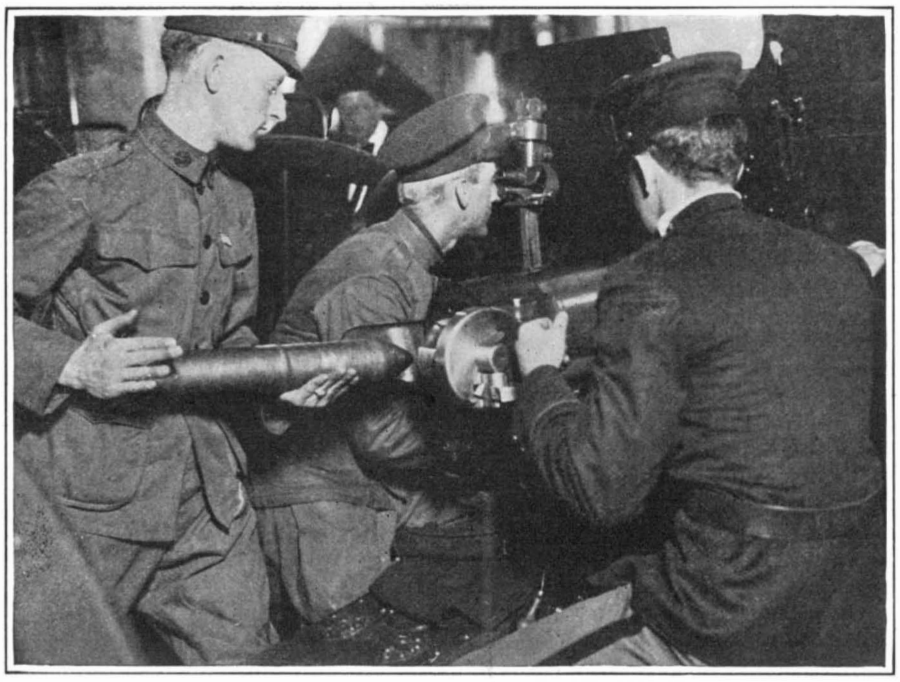
**Acetylene Tanks in Big Fire.**—Probably the most spectacular fire ever staged for the benefit of an awed and admiring populace, occurred in the first week of this month in one of the warehouses of a company making acetylene tanks, charged with gas under pressure. The fire started, it is said, from a defective electric insulation, and soon engulfed the whole building. When the heat reached a certain degree, the fuses in the tanks melted and the acetylene gas was released under great pressure, heightened by the heat. Nearly 8,000 tanks furnished sharp hissing streams of acetylene gas, which burned with such a fierce bright flame that nobody could look toward the fire without using smoked glasses. To try to extinguish such a blaze with water was of course useless, and the great quantity of stored acetylene had to burn itself out.

**Artificial Leather to the Fore.**—The extraordinary increase of the number of motor cars has had a peculiar influence upon the artificial leather industry. While not so long ago "artificial" leather was marketed under names suggesting "leather," and as a sort of apology for the "real thing," its extensive use on automobile tops, automobile upholstery and tool bags, has caused the manufacturers to openly boast of the fact that their product *is artificial!* The reason for this change of heart is found in the custom of some upholstery makers of 'splitting" the cow-hides into several thicknesses, each of which is used as "leather." And the good service which the new watertight top-materials give, is gradually working a change in the motoring public, to the extent that many people deliberately ask for "artificial leather"; tops and covers.

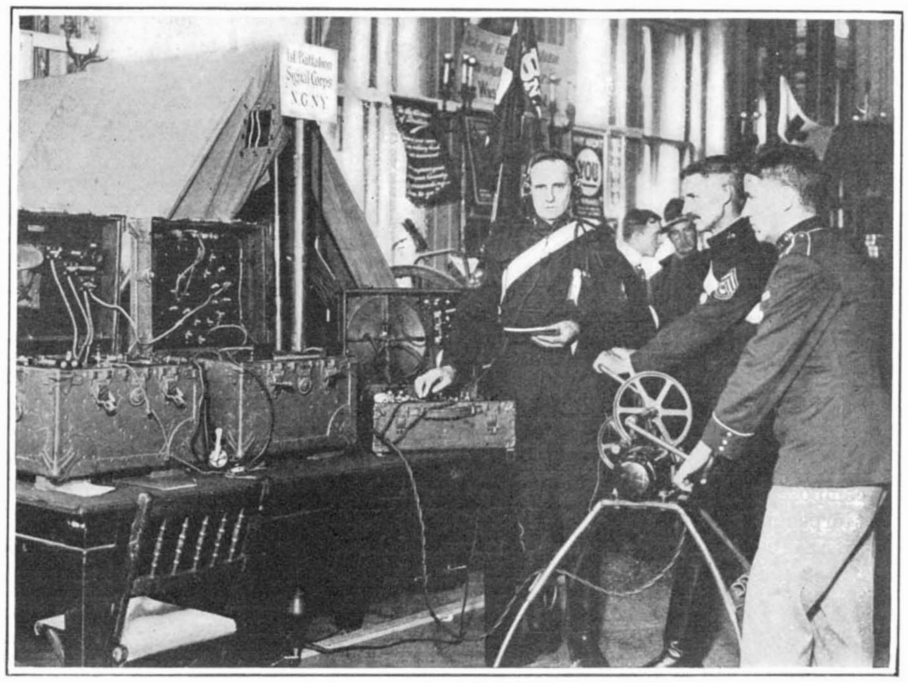
**Queer Causes of Carbonization.**—Practically every owner of a Ford car sooner or later will discover that the first cylinder of his car will carbonize more frequently and more quickly than the other three. For a long time this has been one of the mysteries of the Ford car, and much ingenuity was spent in trying to find the reason. A repair man recently proposed what seems to be the best and most logical answer to the problem: The Ford car has a transverse spring, which in the course of time begins to suffer compression. The front part of the motor therefore sinks slightly below the rear end and the oil in the crankcase flows forward, where it collects below the first cylinder. An excessive amount of lubricating oil is carried into the first cylinder, and carbonization results. As a remedy for this frequent trouble the discoverer suggests a raising of the motor in front by means of a small wooden block.

**$1,180,000,000 in 1915.**—On June 1st, of the present year, the number of automobiles in the United States for the first time reached 2,000,000. Figuring on an average of four persons to each car, which is very conservative, there are 8,000,000 people in this country in daily enjoyment of motoring. What it costs to follow this sport is of interest, because of the stupendous figures involved. To run 2,000,000 cars for one year requires at the very least 1,000,000,000 (one billion) gallons of "gas," worth $130,000,000; 20,000,000 gallons of lubricating oil, worth $8,000,000; 12,000,000 tires, worth not less than $16 a piece, or $192,000,000; accessories and extra comforts, goggles, gloves and caps, at $50 per car equals $100,000,000; garage charges on short tours (exclusive of gas and oil) $100 per car per year, $200,000,000; repairs made necessary by wear, tear and accident (exclusive of tires) $50 per car per year equals $100,000,000. Total running expenses for all cars in use, $730,000,000. Add thereto the value of the 600,000 new cars purchased during the year, at an average price of $750 equals $450,000,000, we get the immense total of $1,180,000,000 spent in a single year (1915) on the sport of motoring.

**Germany's War Car Problem.**—As in many other things connected with the war, Germany's exactness and preparation is first in the field to solve the problem of the used "war car," which looms threatening in the distance. Great Britain and France realize the seriousness of the matter, but so far have not taken a single step to control it. Germany, however, has already made preparations to handle the delicate situation effectively, the moment the war stops. A company has been formed, in which the government and the motor car manufacturers are interested, which company will take over all the cars used in the war, which are capable of repair. They will be put in first-class running condition, and then offered to the public at a reasonable price. Only one third of the total will be placed on the market in the first year, one third in the second year and the remainder in the third year. In the meantime manufacturers of new cars will be able to introduce their product, knowing exactly how many cars, and of what price and condition, will be offered in the second-hand market during a certain time, and can plan their manufacturing and sales campaign accordingly. If, for instance, a certain type of car is especially numerous in the used-car field, manufacturers will "go light" on that type. By such means it is hoped to control the situation and prevent a flood of poor, used cars, at ridiculously low prices.



Loading an army 3-inch field gun.



A field radio set with hand-driven generators.

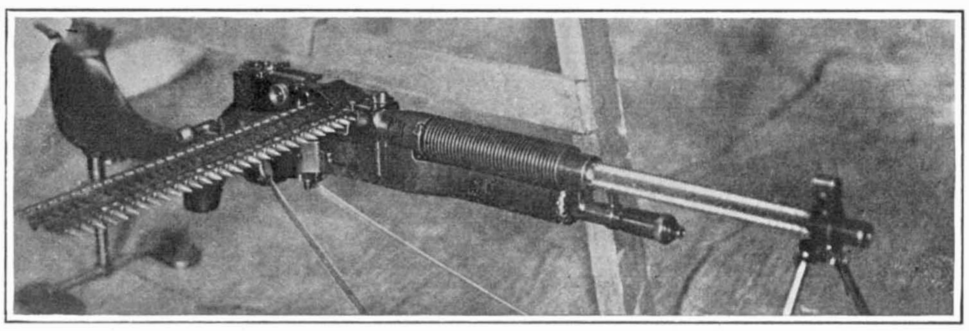
# The Naval and Military Exhibit of the National Security League

## Weapons of Defense for Safeguarding the United States Against Attack

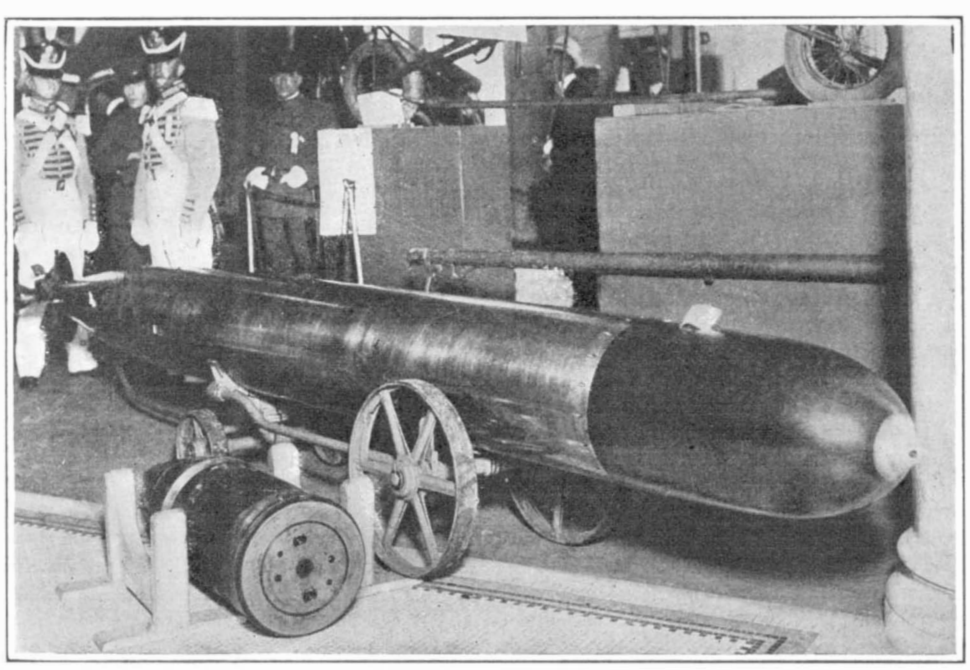
As part of the programme of education of the general public now being carried on by the National Security League, an exhibit was held in New York at the Astor Hotel of some of the very latest naval and military material with which our forces are equipped. We present illustrations of some of the more notable exhibits. Foremost among these was one of our latest 21-inch torpedoes, a weapon which is capable of a speed of 40 knots and has a range of over 7,000 yards. The label stated that the torpedo costs about $7,000, and takes about one year to build; but, as a matter of fact, it is possible to build these in considerably less time if the factories are pushed to their full capacity. Alongside of the torpedo was a 14-inch shell, of the type used in our new naval 14-inch guns. This shell weighs 1,400 pounds, and it is fired with an initial velocity of 26,000 feet a second and an initial muzzle energy of about 65,000 foot-tons. It is capable of penetrating 16 inches of Krupp armor at a range of 10,000 yards, and its maximum range is about twelve miles.

An exhibit which attracted great attention was that of a 3 inch field gun, the type of weapon which has done such effective work during the present war. The accuracy and rapidity of fire of this gun is due to its mounting and excellent sighting devices. The gun recoils in a sleeve which is attached to the gun carriage. The advantage of this is that it is not necessary to readjust the carriage after each round has been fired, the carriage being maintained in position by a deep spade at the after end of the trail, and by the use of brakes on the wheels. The readjustment in elevation is made by an elevating screw, and an important improvement is the introduction of devices whereby the gun itself can be moved in azimuth, or in a horizontal plane, independently of the gun carriage. The bore of the gun is 3 inches, and it fires a 15-pound projectile, which may be either a percussion shell or a shrapnel shell, according to the nature of the attack. There was on exhibition a shrapnel shell, with part of the casing cut away to show the way in which the balls are assembled. The walls of the shell are thin so as to admit of easy and complete fracture, and the shell is burst and the bullets are liberated by a small charge of black powder at the base of the shell. When the shell bursts, the bullets fly forward with the velocity of the shell at the time of bursting, and they are scattered in a wide cone of dispersion.

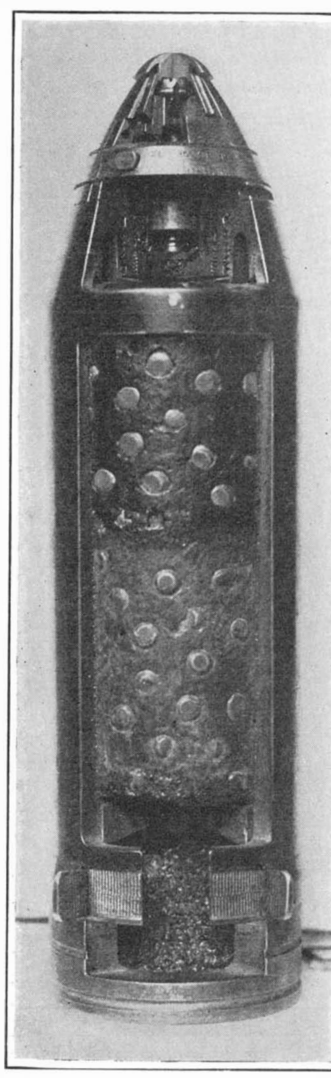
Another exhibit was the new type of air-cooled machine gun adopted by our army, which dispenses with the rather cumbersome water-jacket of the ordinary Maxim type. The piece is light and is capable of firing several hundred shots per minute, the ammunition being carried in a belt which is fed laterally at the breech of the gun. The ejection of the shell, introduction of the new cartridge and all the operations connected with firing are performed automatically.



The new army air-cooled machine gun.



A 21-inch torpedo and a naval 14-inch shell.



Shrapnel shell in section.

Not much has been heard during the present war of one of the most important branches of the service, the Signal Corps, upon whose efficiency depends the ability of the commander-in-chief and the subordinate generals to co-ordinate all the complex movements of the great armies under their command. The Signal Corps had loaned for exhibit a field radio set, one of the interesting features of which was a small generator for furnishing the necessary current, operated by hand-power through a couple of crank handles and set of intermediate speeding-up gears. The crowded condition of the room in which this exhibit was held was one among many evidences of the widespread public interest in the matter of our national defenses which is finding expression in the activities of the National Security League, in the Navy League, the American Legion and other movements to induce Congress to take up the matter of our national defenses in a rational, non-political and thoroughly national spirit.

**"Kewpie" as a Trademark.**—Rose O'Neill Wilson filed an opposition to the application of William Hecht for registration of the word "Kewpie" as a trademark for children's clothes. The Commissioner of Patents granted Hecht's motion to dismiss and appeal was filed to the Court of Appeals of the District of Columbia, which sustained the Commissioner's decision saying, "It is unnecessary to consider in how far the name Kewpie and the thing patented and copyrighted are equivalent or in how far a "Kewpie" may be applied to goods of the same descriptive properties since opposer is not in a position to object to the trademark use of the word by applicant. "Before opposer can be heard, therefore, it must appear that she had used the figure or word "Kewpie" as a trademark on goods of the same descriptive properties as the goods of applicant to which the mark is applied and at a date prior to its use by applicant. In this she totally fails."

# The Aeronautic Lessons of the European War

## In This Experimental Air-War the Brilliancy of the Celtic Mind Has Scored Heavily

By C. Dienstbach

IT may already be safely said that the tremendous struggle now convulsing Europe will probably result in a complete modification of the military aeronautic conceptions that prevailed before the fatal August of 1914. All published reports show conclusively that lessons are learned each day which throw light on the hypothetical surmises of peace. Clearly this air-war is waged on a tremendous scale. The men and apparatus engaged number thousands. Contrary to the experiences and teachings of the Morocco and Balkan campaigns, there is no lack of enterprise in making the most daring experiments.

In discussing what has so far been learned, the strange transformation of news service since August, 1914, must be duly considered. Apart from such delightful fiction as Garros's alleged self-sacrifice, there is enough to bewilder in the most official reports. It was certainly refreshing when recently the British press relieved the endless monotony of "columns of fire rising from hit magazines" (one side), "no damage done" (other side), by the statement that henceforth nothing would be published about the effect of aerial bombardments. While news dispatches have thus to be taken with more than the proverbial grain of salt, the great mass of conflicting evidence may reasonably be worked into a sort of mental composite photograph and some conclusions drawn. It seems certain that aeronautic science *per se* has greatly profited. The courage required in running aircraft seems little compared with the demands made on every private in battle. Such are the *sangfroid* and equanimity of pilots in dealing with the dangers of the air that a military aviator who is a victim of an aviation accident is now a rare bird, although flying in winds against which modern speedy planes hardly make headway, is now common practice, indeed. Increased boldness, not as formerly in winning applause, but in striving for results, also demonstrated such feats of navigation as British aeroplanes finding their way to Cologne and Friedrichshafen over hostile territory, and Zeppelins unfailingly locating darkened English cities. In time of peace it seemed improbable that unsteady aeroplanes would run the risk of attacking each other. Now attack seems simple in the glare of actual war. As the spectacle of universal death has evidently wiped all fear from the consciousness of war aviators, they no more shrink from an aerial encounter than from a horseback fight.

About this actual war in the air, we are already in possession of much enlightening information. As predicted in these columns, air combats are decided with firearms. The former French assumption of hawklike tactics in trying to overmount one another has not thus far been realized. On the contrary, machines at the supreme moment have been saved from bullets by being dropped like a stone to lower levels. The encounters rather resemble those between horsemen, except in not being confined to one level. Long range shots are not resorted to and automatic pistols and carbines rank with machine rifles on aeroplanes (all as predicted in the SCIENTIFIC AMERICAN time and time again). Fast maneuvering for a lucky shot at close quarters handicaps machine rifles, which cannot be aimed as freely in any direction and which also require heavier and more sluggish planes to carry their weight. For the same reason it is not astonishing if, according to the tenor of the reports, German machines often get worsted in these combats. Neither side had adequately prepared for them. The Germans now suffer from having misinterpreted the aerial experiences of the Moroccan and Balkan campaigns and for not having fully appreciated the possibilities of the aeroplane as a fighting machine. Aeroplane duels were not on its programme, because the hired civilian flyers of the Bulgars and Turks did not care to risk their lives in such performances. Interpreting the experiences of the Balkan war too strictly, the Germans developed what they considered ideal scouting machines for war service—very stable, easy to fly, with unfailing motors, very solidly built so as to withstand rough handling, but heavy and comparatively slow. They were also too highly standardized, so to speak, in weight and dimensions. The French equipment remained more experimental, of greater variety, and more adaptable to the novel conditions which developed when true soldiers manned the apparatus. (This German policy seems an exact parallel to their equipping slow battleships with many small guns after the—in the light of dreadnought development—equally inconclusive battle at the Yalu.)

The British, similarly equipped, must be credited with true progressive spirit in dealing with the aeroplane. They made it at once the rule to block the air to hostile craft. In this the French were their apt pupils. As the best information may at present be gleaned from accounts so humble and indirect as to escape the censor's attention, much can be guessed from the description of a Berlin journalist's uneventful visit to a German flying camp in Poland. He casually mentions how elated were German aviators who had been recently transferred from the western to the eastern front because of the cessation of the eternal interference by the enemies' flyers with their scouting.

Courtesy of *Illustrated London News.*

**A Zeppelin pursued by a French biplane.**

The combat in the air has evidently come to stay, but it seems at present in much the same shape as would be the naval warfare of a half civilized country with some battleships, cruisers, and destroyers with navigators but without any trained fighters. Only rough-and-tumble encounters appear to have as yet taken place in the air; the account of a German biplane's victorious escape from a flock of large and small French machines which attacked it from all sides, forcibly reminding one of schoolboy days—of instinctive dodging and wriggling and naturalistic striking. Not only must tactics of air fighting be definitely formulated, but proper types of fighting craft must be decided upon. On the sea continuous scouting and raiding without a decisive general engagement would be inconceivable. Only in the old days when merchantmen with crossbows and hand guns constituted the navies of northern Europe, naval engagements seem to have resembled our aerial duels.

Allied aeroplanes are, as a rule, higher powered for their weight than the German machines, and the fact that they renounce automatic stability of form tends to a further increase of speed and maneuvering and climbing ability. This makes them decidedly the superior fighters. Aerial fighting would change its known aspect if any information were forthcoming about the effect of Zeppelin guns beyond the statement that they brought down British seaplanes over the North Sea. Dirigible fire is essentially different from aeroplane fire; there is no difficulty from vibration or swaying of the platform; the pieces have a perfectly clear arc of fire fore and aft, and the gunnery service is complete and perfect. This permits of longer ranges. The superiority in air combat of even the smallest explosive shell over the bullet has also been conclusively demonstrated, because aeroplanes were riddled into sieves by machine guns and yet escaped because they contain so few parts, and these are frequently armored where a small bullet hole might be fatal. Explosive (percussion) shells, even smaller than those that have been fired by Zeppelins, would, on the contrary, be most efficient against the structure of an aeroplane under the strain of flying.

A gunner of Nelson's days, trained for the destruction of sails and spars, would have been equipped to advise which of our weapons we might best use against aeroplanes. Experience so far has taught about this new ("lost") art that it takes two bullet holes in closest proximity to break a strut. Fuses have been demonstrated which explode a shell even if it hits only the cloth covering of a wing, with the inevitable result that vital parts of the frame are smashed. A cannon's slower rate of fire is thus considerably more than offset by the enormous increase of vital target area resulting from the use of shells. The Germans seem handicapped by the fact that to be the pioneers in a new field has often not proved to be their "*forte*." They prefer to wait and improve on the experiments of others, but it is this time, *hic Rodus, hic salta.*

In this experimental air-war the brilliancy of the Celtic mind has scored heavily. The recent destruction of a Zeppelin by a light high-powered French monoplane, piloted by a daredevil Canadian, who barely escaped being hoisted by his own petard, is a striking instance. The writer pointed in these columns to such a danger in the beginning of the war, reminding readers of the SCIENTIFIC AMERICAN that Germany possessed some identical small, powerful machines in addition to the comparatively clumsy standard type, to convoy and protect Zeppelins, also for fighting hostile aeroplanes. From the accounts it also appears that this Zeppelin carried only a machine rifle, leaving behind its cannon, and it seems more than doubtful whether the latter was so mounted as to sight with ease and quickness vertically at a bomb-dropping aeroplane.

Evidently this Zeppelin succumbed to what has so far proved the most deadly sort of aerial attack—swooping like a hawk with a racing machine and throwing bombs at so close a range that they cannot miss (the writer advocated this five years ago in the *Century Magazine*). These tactics had often proved their value against the ground; high up in the air they are still easier, because the swoop may there be continued past its objective. A light shell-firing, semi-automatic cannon so mounted that it may be brought to bear as instantaneously as a rifle and with a perfectly clear arc of fire in any direction (as it enjoys atop a Zeppelin) will defeat it. A machine gun might turn a swooper into a sieve and yet never ward it off; one hit with a shell at any part of its structure will surely sway it from its path and precipitate it to the ground.

Much must have been learned about bomb dropping in this war, but all we know so far is that it is lavishly indulged in. Reports about its efficiency are so utterly conflicting and information about the methods of aiming so lacking that it is hard to draw any conclusions. The most recent fashion to attack in great numbers deserves credit as the beginning of naval tactics. They have escaped the enemy's guns as luckily as did the Zeppelins, though collectively offering a larger target. The value of aerial scouting, also especially for range-correcting, has of course been paramount. The

(*Concluded on page 636.*)

# The Strategic Moves of the War

By Our Military Expert—June 17th, 1915

DURING the week ending June 17th, 1915, the strategical and tactical moves on the vast European battlefield that have received most attention have nearly all taken place in the eastern and Italian regions. Little or nothing has occurred to indicate that the Germans have abandoned or even materially weakened their offensive campaign against the Russians. On the contrary, the lack of powerful opposition to the Italian advance, the comparative inactivity of the Germans in the eastern theater, and the renewal of active operations in Galicia, all point to a determination on the part of the Teuton allies to follow up the advantage they have gained over the Russians as a result of the decisive operations during the month of May.

Przemysl was captured from the Russians on June 3rd, after a month of the fiercest and most continuous fighting of the war. Both sides must have been practically exhausted. Doubtless the wounded received only such treatment as could be given them in field hospitals. There probably was no opportunity to send them to base hospitals in the rear, for the railroads were taxed beyond their capacity to supply food and ammunition to those able to fight. In war, human life must ever be a consideration secondary to the winning of battles. The Russians were greatly hampered by the confusion and disorganization of retreat and the Germans were employing every available resource to gather the greatest possible harvest from their victory. Decisive victories are won not by breaking through a line or turning a flank, but by the destruction that attends the pursuit of a routed army. But there is a limit beyond which even a pursuing victorious army cannot go, and the Germans apparently reached that limit with the capture of Przemysl, and more than a week of comparative quiet followed.

This period no doubt has been used by both sides in restoring their organization, bringing up reinforcements, replenishing food, ammunition and other supplies, sending the wounded to hospitals at home, and the shifting of portions of the armies to the positions they were to occupy preliminary to the next move. Speed and precision count in these matters the same as on the battlefield, for the side first ready to start afresh has a decided advantage. In the absence of strong reinforcements for the Russians it was to be supposed that the victorious Germans would recover more quickly than the defeated Russians, and this appears to have been what happened.

Viewed from a broad strategic standpoint, the Russians endeavored to cover the retreat of their right and center, which received the full force of the German blow, by a most persistent and vigorous offensive against the German right wing to the eastward in Bukowina. They met with some success here on the Pruth and Dniester rivers, but the danger to the Germans was not so great as to lead them to weaken their driving force in Galicia through fear of disaster to their right in Bukowina. In the end the Russians withdrew this portion of their line to the Dniester, where they blocked the further advance of the Austrians until about June 13th. In the surprisingly short period of ten days (from June 3rd to June 13th) the Germans were able to resupply themselves sufficiently to enable them again to advance in force on a front of about forty miles. They defeated the forces opposed to them, captured many prisoners and made a further material advance on Lemberg, the capital of Galicia and immediate prize for which they are fighting.

The real objective of the German army is not cities or fortresses, however, or even the recovery of Galicia, but the total overthrow of the Russian army. Stupendous as this task may be, still its successful accomplishment may be well within the limits of the German hopes and ambition. The Russian army probably is not in the desperate condition stated in many of the reports from the seat of war, due to the shortage of arms, ammunition and trained men, but if by any chance the shortage exists, this combined with the loss of *morale* incident to the disastrous defeats in Galicia, would be more than sufficient to call forth the Germans' supreme effort. If the Teutons are still hoping to win the war and not merely struggling for an advantageous termination of the war, the destruction of the Russian army is a certain means to this end, if it is not the only means. But an army of this magnitude with a vast country behind it cannot be destroyed in a day, and it is reasonable to expect that Russia will supply her deficiencies long before any such decisive and unprecedented disaster could occur.

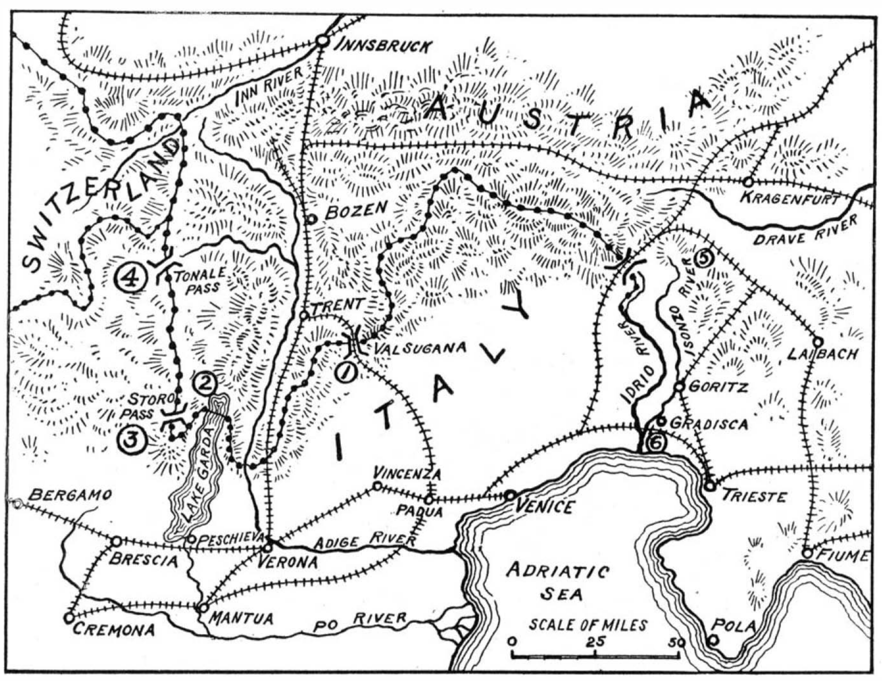
The continued inactivity of the Allies in the west is difficult to understand. There has been daily fighting, to be sure, in this field, particularly at the northern end of the line, but it is fairly devoid of results and has no decisive effect on the general war situation. At no other time since the early weeks of the war, when Paris was saved, has there been a situation so clearly demanding the full offensive efforts of the French, English, and Belgians. Russia is desperately in need of the assistance the western Allies might give her by a drive against the German line in the west, so powerful that Germany would have to abandon her campaign against Russia in order to hold her line in France. Instead, the Allies have continued their policy of "nibbling," which, by the way, seems to be the French translation of "watchful waiting." The Germans also have taken a "nibble" in this theater during the week and, despite the demands made upon them in Russia and elsewhere, have developed sufficient strength in the west to recapture part of the Souchez trenches. We may well ask how long Russia will bear the brunt of the hard fighting without complaining, and whether a small germ of dissatisfaction if once planted might not become in time a menace to concord and unity of action among the Allies.

Italy has continued her methodical advance into Austria along two lines as shown on the map—one force moving into the Trentino on the front (1), (2), (3) (4), and the other moving to the east against Trieste on the front (5), (6). The censorship on reports from Italy has been very strict and little is positively known regarding the strength of the two advancing Italian armies and the opposition they have encountered. Those who hoped for something spectacular to follow Italy's entering the conflict have been disappointed, but there is no good reason why the Allies should be dissatisfied with the progress made by Italy. She took the offensive at the outset, forced Austria to play to her lead, and while she has not pushed far into Austrian territory, she has at least done her fighting on foreign soil and has met with no reverse.

A glance at the map shows the strategic disadvantages of Italy. Whether she advances into Austria by the eastern or northern route, the flank of the invading force and its lines of communications are exposed and must be protected. The left flank of the force advancing on Trieste is, and the railroads in its rear are, open to attack by an Austrian force coming from the north. Similarly, the right flank and the communications of the Italian army advancing to the north on Trent may be struck by an Austrian army coming from the east. These conditions compel Italy to operate in both directions, each of her two armies being a covering force for the other, but under the tremendous strategic disadvantage of becoming more widely separated the farther they advance. It seems highly improbable that Italy will undertake major operations in both directions. Events to date indicate an advance in great strength on Trieste, accompanied by a minor movement toward Trent, the principal purpose of which is to protect the eastern force. Austrian resistance to Italy's advance appears to have hardened, particularly toward Trieste. But the fortress of Trent and the Alps are still Austria's main defense in Trentino.

The principal immediate advantage the Allies could expect to gain as a result of Italy entering the war was a lessening of the pressure on Russia. The continued success of the German campaign in Galicia indicates that the Austrians have refused to strengthen their forces on the Italian frontier at the expense of weakening their armies operating against Russia. It is possible they will go to the extreme of allowing the Italian army to overrun the Trentino and the region of Trieste while they concentrate their entire efforts on the destruction of the Russian army, for with Russia out of the conflict the recovery of lost ground on the Italian frontier would be a comparatively easy task. Besides, if the Allies win, Italy will get the Trentino and Trieste in the final settlement. More probably Austrian opposition to Italy will be greatly strengthened in the immediate future.

The week has produced no material change in the Dardanelles. Both forces are strongly intrenched on short lines with their flanks securely protected by the neighboring waters. This is siege warfare pure and simple and progress must be slow. If the Turks are eventually driven from their present position, and do not quit, they will have plenty of room in their rear for a second stand. The prospects are not good for decisive results here in the near future.




**Map of Italian theaters of war.**

One Italian army of invasion is on the lines 1, 2, 3, and 4. Another Italian army of invasion is on the lines 5 and 6.

### The Current Supplement

ONE of the timely articles in the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT, No. 2060, for June 26th, 1915, is an extremely interesting description of the methods of forging shrapnel shells by means of powerful hydraulic presses, involving features that are not generally known. The article on Mobile Colors, which was announced for the last issue, was unavoidably postponed, but will appear in this number, and will be found well worth reading. So many people are interested in automobiles that the important question of the proper lubricants to be used and the methods of using them will appeal to a wide circle of readers, as proper lubrication is a vital matter in the successful and efficient operation of these indispensable machines. It tells how various lubricants can be tested for quality and gives much information as to their constituents. There have been a number of statements in regard to the process of plating objects by a spray of metal, and the description of a process by an American inventor in this issue adds greatly to the information on this subject. Two fine illustrations and a brief description tell the story of a large gas engine built for blowing air in iron and steel furnaces. The exhaustive article on the Chemical Industries of Germany is concluded in this issue. An article of real practical value treats of the Construction of Floor Surfaces in Fireproof Buildings; and there is the usual variety of informative matter in shorter form. This issue is also indispensable, as it contains the Index covering the issues of the past six months.

**Wanted—a New Solid Tire.**—One of the lessons learned in the European war has been the fact that a new type of truck tire is absolutely necessary. While in ordinary street service and on country roads in peace times the standard solid truck tire is fairly effective and reliable, it has shown many defects in the terrific driving strains of war service. It has been shown, for instance, that no matter how well made a tire is, it will separate at the point of contact between the soft rubber and the hard rubber parts. The hard rubber base, used in the majority of truck tires, has a different coefficient of heat and friction from the soft rubber section. In hard service, particularly when driving over Belgian block pavements, the two sections of the tire will come apart, and sometimes strip off suddenly under a particularly heavy strain. On a few occasions such accidents have proved exceedingly expensive, one truck carrying shells being completely wrecked while traveling at high speed over the *pavé*. Tests are now carried on in several tire factories with the idea of evolving a truck tire in which the soft rubber merges gradually into the hard rubber base.

## The Damage to the American Ship "Nebraskan"

THE torpedoing (if such it was) of the American freight ship "Nebraskan" forty miles off the southwest coast of Ireland, occurred at dusk and shortly after the ship had taken in the American flag which had been flying at her stern. The presumption is that, in view of the activity of German submarines in this locality, notably in the case of the sinking of the "Lusitania," the ship must have suffered the damage shown in the accompanying illustration as the result of deliberate submarine torpedo attack. As will be seen from the photograph, she received the blow well below the waterline and on the starboard bow. It was because she was struck so far forward, where the compartments are small and the subsequent flooding was comparatively limited, that the ship was able to be taken into port and placed in drydock. The German government professes to have received no report from any submarine commander, or any other source, of any attack on this ship; but in view of the lack of veracity of such official statements, notably in the case of the "Lusitania," this evidence carries practically no weight. It has been suggested that she may have struck a drifting mine; but if this had been the case, the blow would have been at the waterline. At the present writing, dispatches from the other side state that fragments of metal have been forwarded from our embassy which indicate that it was a torpedo which did the damage. The ship was subjected to a thorough expert examination by one of the naval constructors of the United States Navy, and it will be necessary to await his report on the subject before forming a final and positive conclusion as to whether the damage to the American ship was accidental or deliberate.

## A Serious Interruption

THE Commissioner of Patents has, under date of June 10th, 1915, published a notice to the effect that, on account of the unusually large number of patents issued during the current fiscal year, the regular appropriation of $440,000 for printing patent specifications and the *Official Gazette* of the Patent Office, and the supplemental appropriation of $125,000, have been nearly exhausted, and that it will therefore be impossible to issue the *Gazette* for June 15th, 22nd and 29th, on those dates. The notice goes on to state that the issues referred to will be sent out as early in July as the publication can be effected, and that owing to the resulting congestion there probably will be some delay in the issues of the *Gazette* for July until conditions in the office of the Public Printer again become normal. It is to be greatly regretted that such a situation can obtain, notwithstanding that, as Commissioner Ewing says, there will be no delay in the issues of patents, designs, or trade-marks. It would seem that so important a branch of our Government as the Patent Office, particularly in view of the fact that it is more than self-supporting, should not be hampered, in even the slightest degree, by too strict a spirit of economy on the part of Congress, or for lack of foresight in providing the necessary appropriation for carrying on the details of its work. The *Official Gazette* is an exceeding important publication and is of interest and real need to a large number of our citizens. Certainly every effort should be made to avoid hereafter any such interruption in the publication of that organ. The regular issuance of the *Gazette* is especially important in connection with trade-marks, as all applications for trade-mark registration which have been passed by the Patent Office are published in the *Gazette* for a period of thirty days, during which period such applications may be opposed by interested parties, and for this, if for no other reason, any delay in the publication of the *Gazette* should be obviated.

## Shooting Spectacles*

THE eyesight of soldiers and sailors is often injured, temporarily or permanently, by direct or reflected sunlight. The injury is caused chiefly by the invisible ultra-violet rays, which are absorbed by the tissues of the eye.

In the outer parts of the eye these rays cause disagreeable sensations, which are commonly included in the term fatigue. The eyelids become heavy and red, tears flow, and there is a sensation of pressure, itching and burning. Long continued or repeated exposures to the sun's rays may produce catarrh of the conjunctiva. In extreme cases, occurring in mountain climbing, polar exploration and balloon flights, the acute inflammation known as snow blindness is observed. This ocular inflammation is closely connected with the "glacier-burn," which is also produced by the ultra-violet rays. On several occasions the movement of armies over snow-clad mountain passes has been impeded chiefly by these effects of sunlight.

When ultra-violet rays penetrate more deeply into the eye, they evoke fluorescence in the lens and the retina. The glow-worm light thus produced in the eye itself spreads a haze or fog over external objects in the field of view. The small proportion of ultra-violet rays that reaches the retina diminishes the ability to see in dim light.

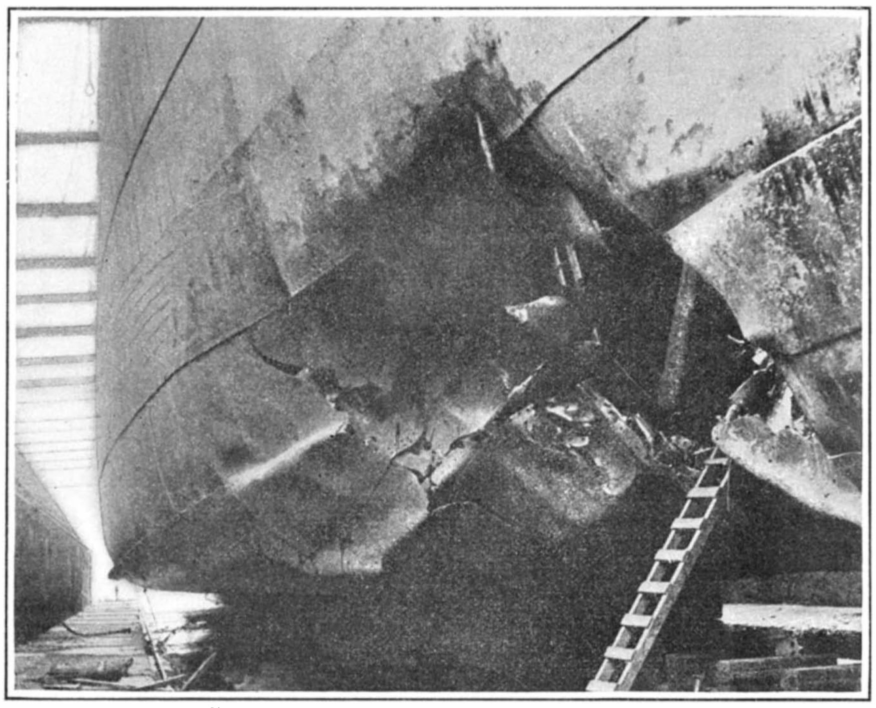
Hence the exclusion of these injurious rays from the eye is very desirable, especially for riflemen and gunners. The newly invented greenish-yellow "euphos" glass absorbs the ultra-violet rays, together with part of the blue and violet rays, which contribute to the injurious effects above described, but freely transmits the rays that are useful for vision. The partial exclusion of the blue and violet rays presents another advantage in twilight, as it makes the blue evening clouds darker and gives prominence to objects of red and yellow tints.

I have often used these euphos glass spectacles in target practice on sunny days, to the great improvement of my marksmanship. I have also repeatedly employed them at sea, as a protection from the glare of the sun on the water. In particular, I have observed vessels immersed in this glare at the horizon and have made out many details which I could not distinguish with the unprotected eye. I have observed in this way for hours without experiencing any unpleasant sensations. Dr. Gross, who has had similar experience, says that the euphos spectacles diminish the width of the dazzling bright strips of water, sharpen the outlines of vessels and other objects at the horizon in the illuminated area, and are very useful in observing and aiming in the presence of searchlights.

Major Meyer, viewing the receding coast from the stern of an outgoing vessel, with the sun directly astern, observed with the naked eye a dazzling gap in the coast line, which closed up when the euphos glasses were used. Dr. Flemming wore light euphos glasses in a balloon flight attaining an altitude of more than 26,000 feet and experienced no inconvenience, while his companion, who wore dark gray glasses, suffered severely. Amundsen took with him on his Antarctic expedition a large assortment of protective glasses, including two pairs of light euphos glasses. Amundsen and Hansen, who wore the euphos glasses, were the only members of the party that escaped snow blindness.

The theoretical expectations formed by the euphos glass have, therefore, been realized in practice. There is no better protection against snow bindness than spectacles of euphos glass, and their employment also produces a notable improvement in marksmanship.

* Adapted from Dr. Schanz's article in *Die Umschau*.



Copyright by International News Service.

**Bow of the "Nebraskan," showing damage wrought, supposedly by a submarine torpedo.**

## Who Invented the Circular Saw?

SOME discussion of this subject has appeared in several British technical publications, and the claim is made that the circular saw was invented and used by a wood turner named Murray at Mansfield, England, about the year 1820. The first saw is described as having been about six inches in diameter, and was undoubtedly used on a wood turning lathe operated by water power. James Murray, the inventor, is said to have been the son of "Old Joe Murray," the favorite servant of Lord Byron.

# Correspondence

*[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]*

## Waterproofing Concrete

To the Editor of the SCIENTIFIC AMERICAN:

Two or three recipes have been published in your paper, at various times, for waterproofing concrete. There seems to be a good deal of popular misconception on this subject, and it has occurred to me that a few notes I have gathered on the subject during a number of years' experience superintending concrete work, might be of interest to your readers.

No concrete can be made entirely waterproof. The best concrete, if subjected to water under high heads, will leak considerably. And even under very low pressures there is leakage, though it is so slow that the water leaking away evaporates as fast as it leaks and leaves an apparently dry surface. But, for practical purposes, a 1:2:4 mix, if made of a medium consistency and thoroughly tamped in place, will be waterproof under small pressures, say up to 15 pounds to the square inch. The more thorough the ramming, the more nearly waterproof the concrete. I have seen one case in which the pneumatic rammer was used, where the concrete was sensibly waterproof under 40 pounds per square inch pressure, without any further treatment.

Various compounds of alum and lye or soap are often mixed with concrete, to increase its waterproofing. One of the best known of these was published in a recent number of the SCIENTIFIC AMERICAN. Add three fourths pound of dry powdered alum to each cubic foot of sand and dissolve three fourths pound of soap in each gallon of water. Use one part of cement to two parts of sand and four parts of gravel. But I question whether the gain made by this method is worth the extra trouble. The same result can be reached by washing the surface of the concrete on the water side with a wash of one part concentrated lye and two parts alum, dissolved in sixteen parts water. Two or three coats of this solution should be applied, allowing time for each coat to dry, before putting on the next. This method is much less troublesome than the previous method and gives results as good.

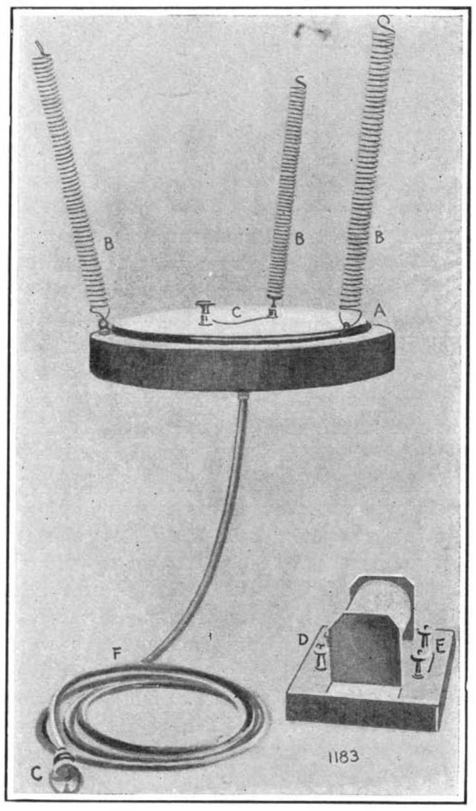
Another method in common use is to add from 5 to 10 per cent of hydrated lime to the cement before mixing, the proportions of mix being one part of the cement-lime mixture, two parts sand, and four parts gravel. This gives very good results, though it weakens the concrete slightly. On small jobs, where the cost is not of very great importance, a mixture of one part cement, one part of sand and two or three parts gravel, without any further treatment, is waterproof against moderately high pressures. The writer has seen one case, that of a pressure pipe line, where a 10-inch wall of this mixture was sensibly watertight against a pressure of about 65 pounds per square inch. But, in most cases, the cost of so rich a mixture is prohibitive.

Where concrete must be waterproofed against very high pressures, none of the above methods seems to be effective, and other means must generally be resorted to. The usual practice under these conditions is to coat the surface on the water side with asphalt, pitch, or alternate layers of pitch and tarred felt. Paraffine, melted and applied hot with a brush, has also been used very successfully, but this is rather costly where there is a large surface to be covered.

Seattle, Wash. LEO G. HALL, Civil Engineer.

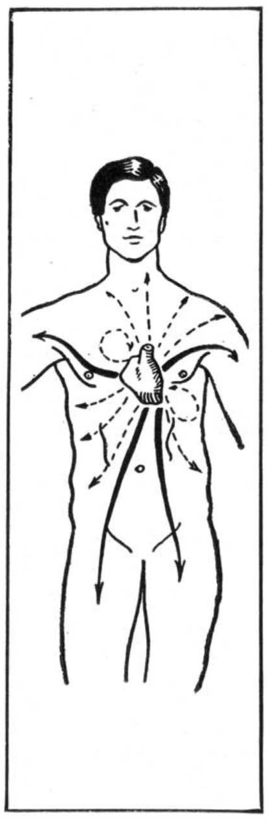
## The Engineering Foundation Organized

SOME months ago announcement was made of a gift of $250,000 by Ambrose Swasey of Cleveland, which was to be the nucleus of a fund to be devoted to research work in engineering lines and to the promotion of the interests of the engineering professions. No further contributions to the fund have been made, but the Engineering Foundation has been organized, at a recent meeting at the Engineering Societies Building, 29 West Thirty-ninth Street, New York, with the following officers: Gano Dunn, chairman; Edward D. Adams, vice-chairman; F. R. Hutton, secretary; and Joseph Struthers, treasurer. A large number of applications from those who desired the use of some of the funds for research work were already on file, but these will be held pending the filing of further specifications in accordance with forms to be drawn up by a committee appointed for the purpose.



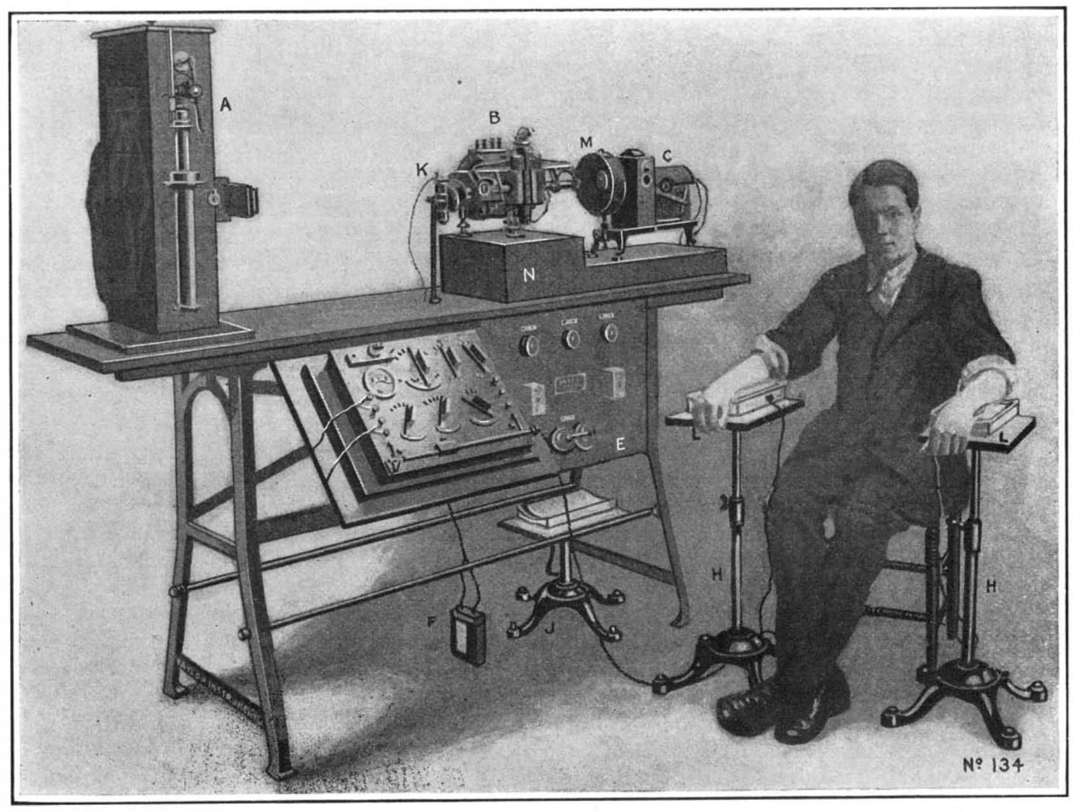

**Apparatus for phono-cardiography.**

*C*, microphone; *B, B, B*, spiral supporting springs; *G*, stethoscope; *D*, relay.



**Human power plant.**

Position of the heart and distribution of currents.




**Complete apparatus for electro-cardiography.**

*A*, camera; *B*, galvanometer; *C*, lamp; *D*, switchboard; *E*, keys, etc.; *F*, battery; *K*, chronographs; *L*, salt water baths used as electrodes; *M*, vessel of water for absorbing heat of rays.

# The Instrumental Study of the Heart

## Methods by Which Its Action and Condition Are Observed and Recorded

IT has long been known that every muscular contraction is accompanied by a difference of electric potential between the active, or contracting, part of the muscle and the passive part, so that, if the two parts are connected by a wire, a galvanometer interposed in the circuit will indicate the presence of an electric current.

The heart is a muscular organ and its rhythmical contractions, or beats, produce short-lived current which normally flows through the tissues of the body, but can be diverted to an external circuit. Currents were detected in the frog's heart by Koelliker and Mueller in 1856, but it was not until 1887 that Waller succeeded in recording human heart-beats on a photographic plate, with the aid of Lippman's capillary electrometer, and the first satisfactory electro-cardiograms were obtained by Bayliss and Starling in 1892.

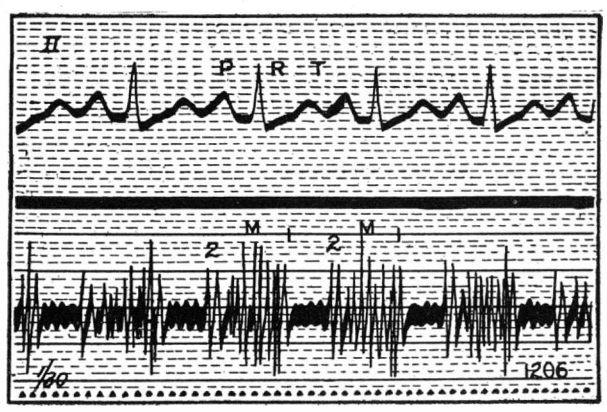
The development of electro-cardiography as a practical method of diagnosis began with the researches of Prof. Einthoven of Leyden, early in the present century, and his invention of an exceedingly sensitive instrument for measuring small currents—the Einthoven string galvanometer. In this instrument the current traverses a very fine and tightly stretched wire (or a silver-plated filament of glass), which passes vertically between the closely approximated poles of a powerful electromagnet. The part of the filament that crosses this strong magnetic field is displaced more or less to the right or left, according to the direction and strength of the current. The filament is illuminated by an arc lamp and condensing lens, and its shadow is thrown across a horizontal slit by a projecting microscope. A cylindrical lens forms on the photographic plate an image of the slit, in the form of a narrow bright band, on which the magnified shadow of the filament appears as a black dot. It is evident that if the plate is moved vertically with uniform speed the movements of the filament will be recorded in the form of a sinuous line.

In order to measure the movements, the cylindrical lens is engraved with equally-spaced vertical lines, which appear as fine horizontal lines in the cardiogram. The vertical lines of the record mark intervals of time, and are produced by momentarily interrupting the beam of light by the teeth of a uniformly rotating wheel.

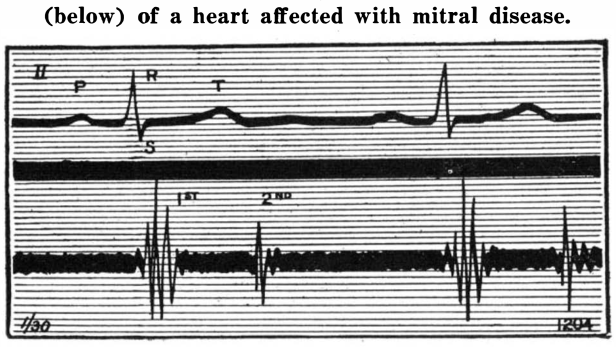
It is impossible to place wires directly in contact with a man's heart, and it is not necessary to do so, for the heart-currents permeate the whole body and may be taken off by connecting almost any two parts of its surface. In practice three circuits are used: Circuit I, from the right arm to the left arm; circuit II, from the right arm to the left leg; circuit III, from the left arm to the left leg.

The two selected limbs are connected through the galvanometer by immersing them in vessels of brine into which dip porous cups, filled with zinc sulphate solution, and containing the zinc terminals of the galvanometer wires. The glands of the skin produce a nearly constant current, which is called a "rest current" in contradistinction to the "action currents" caused by muscular contraction. This rest current must be compensated by an accumulator or otherwise. It is necessary, also, to standardize the apparatus, by means of a rheostat, so that a given electromotive force shall always produce the same deviation of the galvanometer filament and, consequently, the same elevation or depression in the sinuous line of the record.

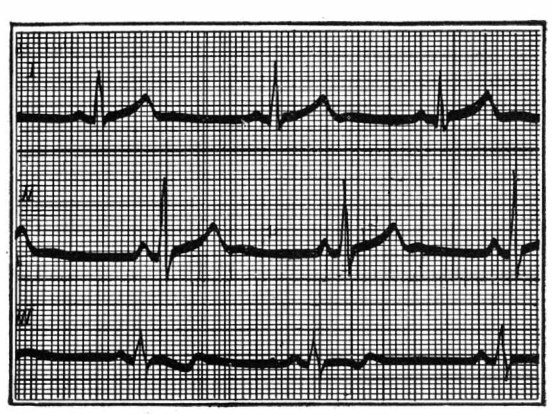
The record may be made on a glass plate, which is attached to a hollow leaky piston plunging into a cylinder filled with oil, so that it descends with uniform speed by its own weight. It is better, however, to use a band of photographic paper or film moved uniformly by clockwork, or an electric motor.




**Electro-cardiogram (above) and phono-cardiogram (below) of a heart affected with mitral disease.**




**Electro-cardiogram (above) and phono-cardiogram (below) of normal heart.**




**Normal electro-cardiograms for the three circuits.**

Various forms of apparatus are used. The foregoing description applies chiefly to the apparatus which is now furnished by the Cambridge Scientific Instrument Company.

Hitherto, almost all electro-cardiograms have been made with the Einthoven string galvanometer, but the difficulty of managing the optical apparatus and regulating the tension of the filament has led Siemens and Halske to construct for this purpose a special form of the mirror galvanometer, which is used in physical laboratories. In this instrument the current to be measured traverses a coil of very fine wire delicately suspended between the poles of an electromagnet. The coil carries a little mirror which reflects a spot of light to the photographic film.

The contractions of the heart do not occur simultaneously in every part. They begin in the auricles, at the base of the heart, and thence spread through the ventricles, which occupy the greater part of the organ. Each complete cycle of the heart is represented in the electro-cardiogram by three elevations, separated by nearly level portions. The first elevation corresponds to the contraction of the auricles. The second and third elevations are produced by the progressive contraction of the ventricles, and the level line between them indicates, not a cessation of contraction, but the balancing of opposing electromotive forces in different parts. The second elevation is as high as the other two combined, and is usually preceded and followed by a slight depression.

The electro-cardiograms obtained from the three circuits (I, II and III) exhibit differences which are particularly important in the examination of a diseased heart. The same circuit is not the most useful for diagnosis in all cases.

The string galvanometer is also used, in connection with a microphone, to record the sounds of the heart. A phono-cardiogram and an electro-cardiogram can be made simultaneously by employing two galvanometers.

The sounds of the heart were registered, imperfectly, by Hurthle, by converging them through a stethoscope to a microphone connected with the primary coil of a transformer. The currents induced in the secondary coil were employed to produce contractions in a frog's leg, and these contractions were recorded by a myograph. Einthoven and others have employed a microphone connected with a telephone receiver, the vibrating membrane of which was attached, by a rod, to a slightly convex glass plate, in contact with a plane plate. The contraction and expansion of the Newton's rings thus produced were photographed on a band of paper.

The simpler and far superior string-galvanometer method employs a microphone mounted in a heavy iron ring, which is suspended horizontally by three spiral springs. The sounds of the heart are conveyed to the microphone by a stethoscope and a rubber tube. The microphone is connected with the primary coil of a transformer, whose secondary coil is connected with

the string galvanometer. The movements of the galvanometer filament are recorded in the manner already described.

The phono-cardiogram thus obtained shows oscillations, arranged in groups, which are nearly synchronous with the second and third elevations of the electro-cardiogram. These oscillations are especially intense and instructive in cases of valvular disease.

These new electrical methods of recording the contractions and the sounds of the heart possess the great advantage of applicability to patients at a distance. Einthoven, in his laboratory, made electro-cardiograms of patients in a hospital more than a mile away, and several great hospitals are now provided with electrical connections by which patients in the wards can be connected with electro-cardiographic apparatus situated in a special laboratory. In this way the patient is spared fatigue and the excitement caused by the sight of the apparatus, both of which are especially injurious and disturbing in heart disease. Before long, possibly, the public telephone system will be impressed into this service, and the eminent specialist, seated in his office, can examine the hearts of patients who remain in their distant homes.

Dr. Tussier, a collaborator of Dr. Carrel, recently described a bold and original attempt to treat valvular disease of the heart by surgical methods. While we admire the skill and daring manifested in this and similar surgical exploits, it is well to remember that they have been made possible by the researches of the infamous vivisectionists who are held up to the public execration by certain supersensitive souls. These researches have enabled us, not only to modify the natural conditions of the heart's action, but even to revive a heart that is apparently dead. This resurrection of the heart is shown in the following striking experiment.

A frog's heart is excised and, after it has ceased to beat, an artificial circulation is established in it, either with defibrinated blood, or with a wholly artificial serum. In a few seconds the heart begins to beat again. If the beats of this "isolated" heart are recorded on a rotating cylinder by appropriate mechanism the record shows that they exactly resemble the beats of a living frog's heart in rhythm, frequency and amplitude.

A highly refined and perfected apparatus of this kind devised by Pachon, shown in one of the accompanying illustrations, permits of the study of the effect of various solutions on the heart of a warm blooded animal. The heart is electrically stimulated and performs its functions as though in the body. The solutions are passed through the heart as is the blood when the heart is performing its offices in the living animal.

In this apparatus the arrangement of the two pressure tanks is particularly ingenious. The pulleys permit them to be raised and lowered as necessity demands and the connection of an air pipe from one tank to the other as well as the pipe through which the solution flows insures a practically uniform pressure.

An even temperature is maintained by heating the bath in the tank by means of gas burners which are directly beneath the bath chamber. The use of three jars in the bath chamber allows experimentation with as many solutions.

The manometer indicates the blood pressure. The apparatus to the extreme left records the heart beats with an ink pen on plain paper which surrounds the roll.

The electric battery with bell is connected with the electric thermostat and rings a bell if the temperature rises above or falls below a certain point. As an insurance against temperature changes the bath tank is built with two walls having an air space between them.

While there have been a number of clever mechanisms constructed during the past generation to promote the study of the vascular mechanism this one has been thought out with greater attention to detail than any hitherto known, and the result in control of pressure and temperature leaves little to be desired.

By gradually improving their methods physiologists have obtained the same result with isolated hearts of rabbits, dogs and other mammals, maintaining their functional activity for many hours.

This method has produced important practical results. It permits us to study the properties of the active cardiac muscle, which are very different from those of other muscles.

For example, the contraction of a skeletal muscle is proportional to the stimulus which evokes it, but the cardiac muscle contracts to its maximum extent or not at all. The method also facilitates the study of the factors that influence the heart's contractions (temperature, physical and chemical agents, etc.). By varying the composition of the irrigating serum different curves are obtained which indicate differences in the force, frequency and form of the contractions. This method is very valuable for the study of the effects of medicines upon the heart because, in the isolated heart, these effects are not masked by other physiological reactions, as they often are in the living subject. For example, the addition of a trace of chloroform to the irrigating serum stops the beating of the isolated heart instantly, and often permanently. This proves that chloroform is a heart-poison and explains the fatalities that occur in anesthesia produced by chloroform. Small doses of caffeine, on the contrary, augment the frequency and amplitude of the beats of the isolated heart, and digitaline increases the energy of its contractions.

These experiments are most successful when they are practised upon the isolated heart soon after its removal from the body, but they can be performed hours or even days after its excision. A dog's heart has been revived after four days, a rabbit's heart after five days, a tortoise's heart after eight days of isolation.

Can the same miracle be wrought upon the human heart? The heart of a beheaded criminal has been observed to beat spontaneously twenty-five minutes after decapitation, and it has been found possible to restore the heart's beating, by massage, forty minutes after it had stopped.

Improvements in the artificial circulation may enable us to revive the heart of a man as well as that of a dog.

The heart is not the only tissue that survives removal from the body. The muscles of the frog and the tortoise are able to contract ten days after excision; fragments of intestine have been kept alive a week; segments of arteries retain their contractility twenty days; and spontaneous movements of the eyes and face of a beheaded criminal have been observed ten minutes after decapitation. When we collate these facts, and make the very probable assumption that the survival of organs and tissues will be prolonged when we shall have learned more of the physical and chemical conditions

(Concluded on page 636.)

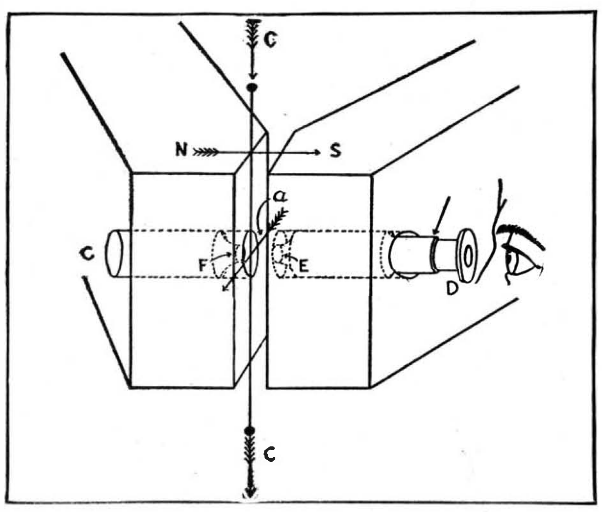
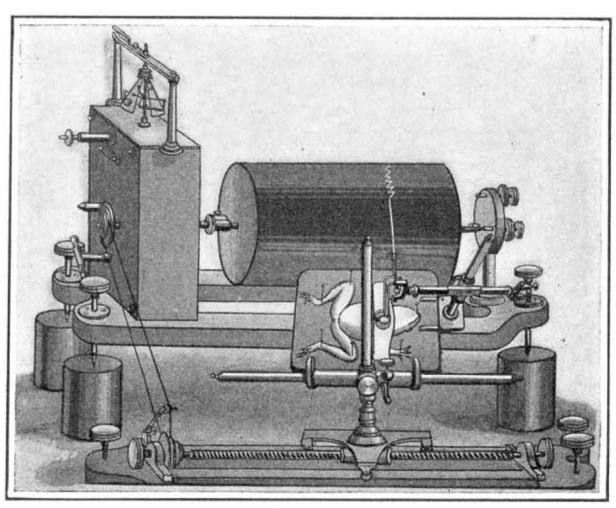
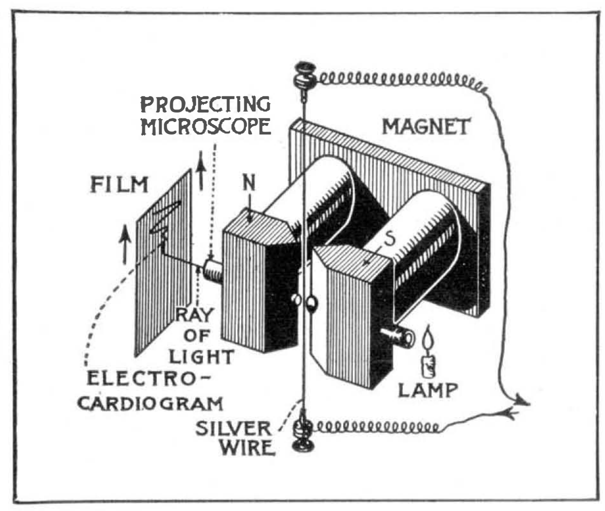


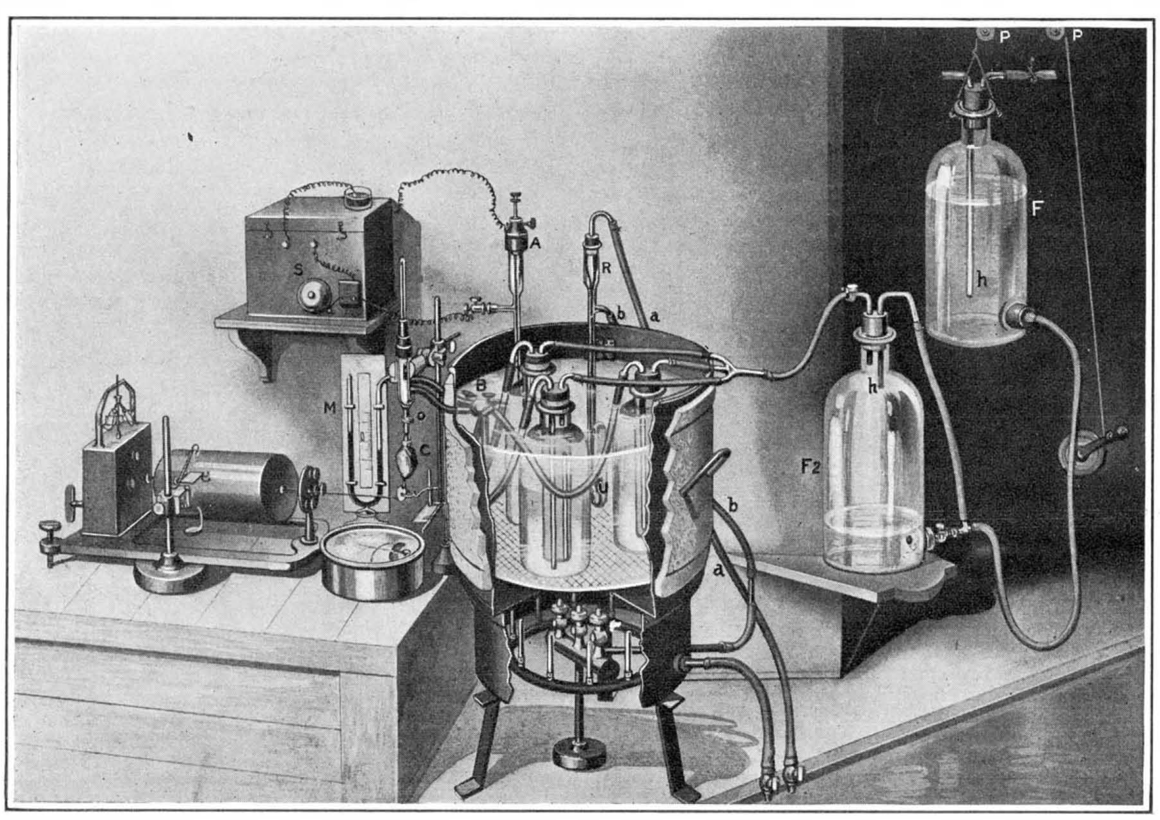

Diagram of the Einthoven string galvanometer.



Recording the contraction of a frog's heart.

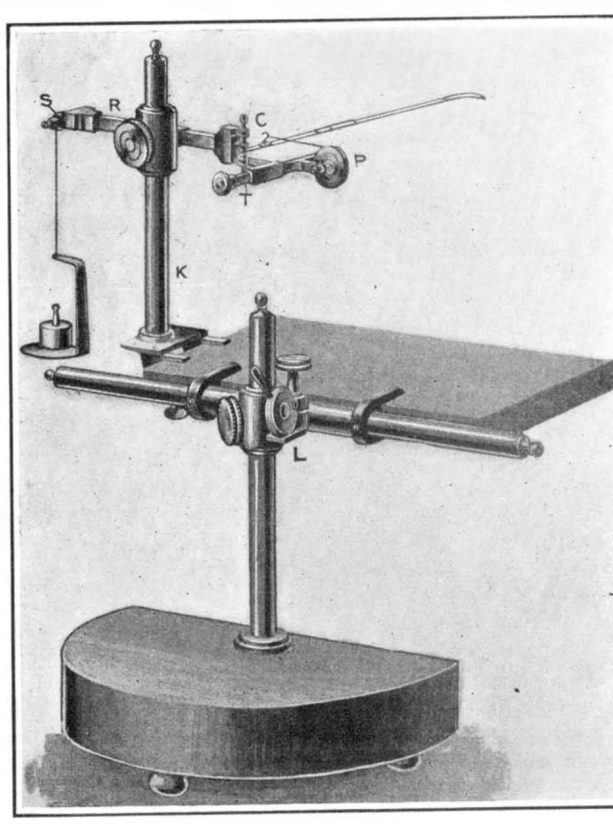



Einthoven galvanometer recording heart currents.



B. Pachon's apparatus for irrigating the isolated heart with artificial serum.

*A*, electric thermostat; *R*, gas thermostat; *B*, three-way connection; *C*, excised heart; *V*, bath to keep solutions at even temperature; *M*, manometer; *S*, battery, controlled by thermostat, rings bell on change of temperature; *F*, *F*², pressure tanks; *e*, apparatus for recording heart action.



The traction cardiograph.

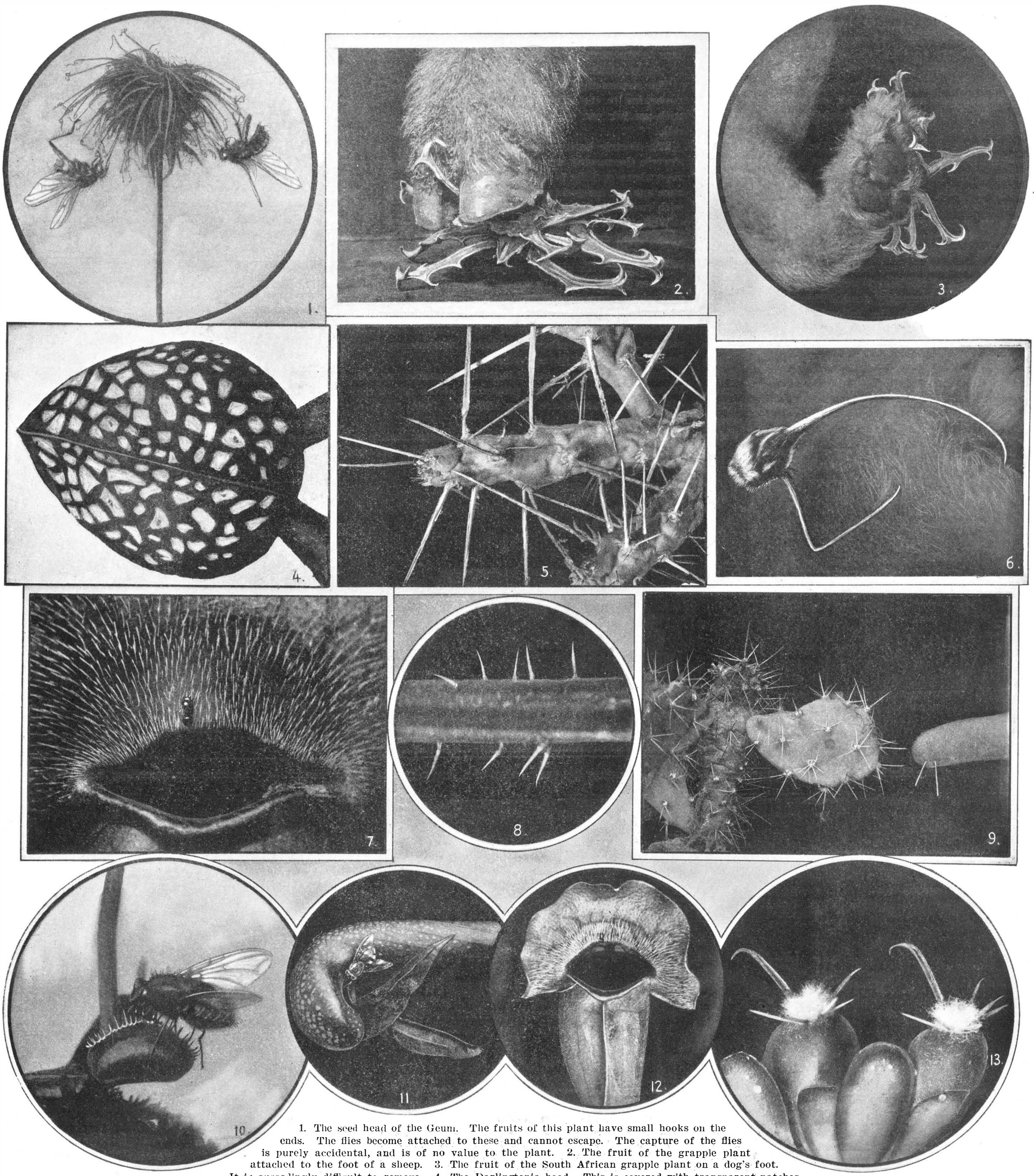
*L*, adjustable support for the operating table; *K*, support for recording devices. Connection with a frog's heart made by cord over the pulley *P* and attached at *C* to a siphon recorder.

# Are Plants Cruel?

## Brutal Injuries Inflicted on Insects and Animals

By S. Leonard Bastin

ONE cannot help thinking that many plants are unnecessarily brutal in some of the methods which have been adopted. It is, of course, well known that a certain number of species find it needful to capture insects in order that they may supplement their supply of nitrogenous food. In most of the schemes the unhappy victim is doomed to undergo the torture of a lingering death. Very rarely is the insect killed at once. First of all let us consider the case of the Darlingtonia, a plant which usually catches winged insects. The flies are lured by honey secretions to enter the hooded process at the top of the pitcher-like leaf. This



1. The seed head of the Geum. The fruits of this plant have small hooks on the ends. The flies become attached to these and cannot escape. The capture of the flies is purely accidental, and is of no value to the plant. 2. The fruit of the grapple plant attached to the foot of a sheep. 3. The fruit of the South African grapple plant on a dog's foot. It is exceedingly difficult to remove. 4. The Darlingtonia hood. This is covered with transparent patches which the captured flies mistake for openings. They beat themselves to death in vain endeavors to escape. 5. The terrible spines of a West Indian cactus. The smaller ones catch hold of the flesh and are very difficult to pull out. 6. The fruit of the South American Martynia has enormous hooks which are many inches in length. These plunge into the flesh of animals. 7. The bristles at the mouth of the pitcher of the side-saddle plant all point downward. Thus the unhappy insect, trying to escape from the pitcher, is thrust into the yawning pit below. 8. Why the nettle stings. The hairs (enlarged) show the little bulbs of poison at the base. The effect of some tropical nettle stings will last for days. 9. A cactus with minute barbs on its spines. The spines are loosely attached, and after penetrating the flesh, come away and are likely to cause blistering wounds. 10. The Venus fly-trap will not infrequently capture flies which are too large for its purpose. These wear themselves to death in vain endeavors to escape. 11. Darlingtonia Californica. This plant tempts flies to enter its curious hood. The insects cannot escape and are used by the plant as food. 12. The mouth of the pitcher of the Sarracenia is covered with hairs which makes escape impossible for the unfortunate insect. The hairs all point downward. 13. The "wait-a-bit" cactus. The hook catches hold of the tongue of the animal and inflicts terrible injuries.

**The cruelty of plants.**

they do by means of an opening on the underside. The whole of the upper portion of the hood is covered with transparent patches like so many windows. Now when the fly wishes to leave he naturally flies upward toward the light which streams down through these windows. The real opening is hidden in the shade of the under part, and passes unnoticed. Thus the flies simply beat themselves to death, in a vain endeavor to escape through the transparent places. This proceeding may extend over hours, but it always has one ending. The fly falls exhausted into the fluid at the bottom of the pitcher, and is drowned.

Very much the same thing happens in the case of the Side Saddle plant (*Sarracenia*). Here the insect is lured into the interior of the pitcher, but the exit at the mouth is barred by numerous sharp bristles which all point downward. It is almost impossible to crawl up against these processes and, after many futile attempts, the small beetle falls back into the horrible pit beneath.

Many flies meet with peculiarly brutal deaths in connection with the Venus fly trap. In an accompanying photograph is shown a capture by this plant. Here the victim was a large blue bottle fly, too big a specimen for the leaf to inclose. The insect was captured by its legs and held fast; meanwhile it beat its life away in vain endeavors to escape. An even more singular case was that to be observed in the fruiting head of the Geum. Here the fruits have small hooks, and the legs of flies are entangled in the processes. They cannot escape, and so must die miserably. The happening is, of course, a pure accident, and the flies are of no value to the plant.

The manner in which the dispersal of seeds is secured often involves happenings of a peculiarly brutal nature. In the first place let us take the case of the fruit of the Martynia, a South American plant. Here the capsule is armed with terrific hooks, sometimes as much as 5 or 6 inches in length. These are curved in such a way that they seize hold of passing animals, and plunge deeply into the flesh. It is said that bullocks are often driven half frantic with the pain produced by the cruel hooks. Frequently the most dreadful wounds are the outcome of the presence of the Martynia fruits, and the unhappy creature may not be able to get rid of its burden for several weeks. Of course the final result is that the seeds of the plant receive a very wide distribution, but a large amount of needless suffering seems to be involved.

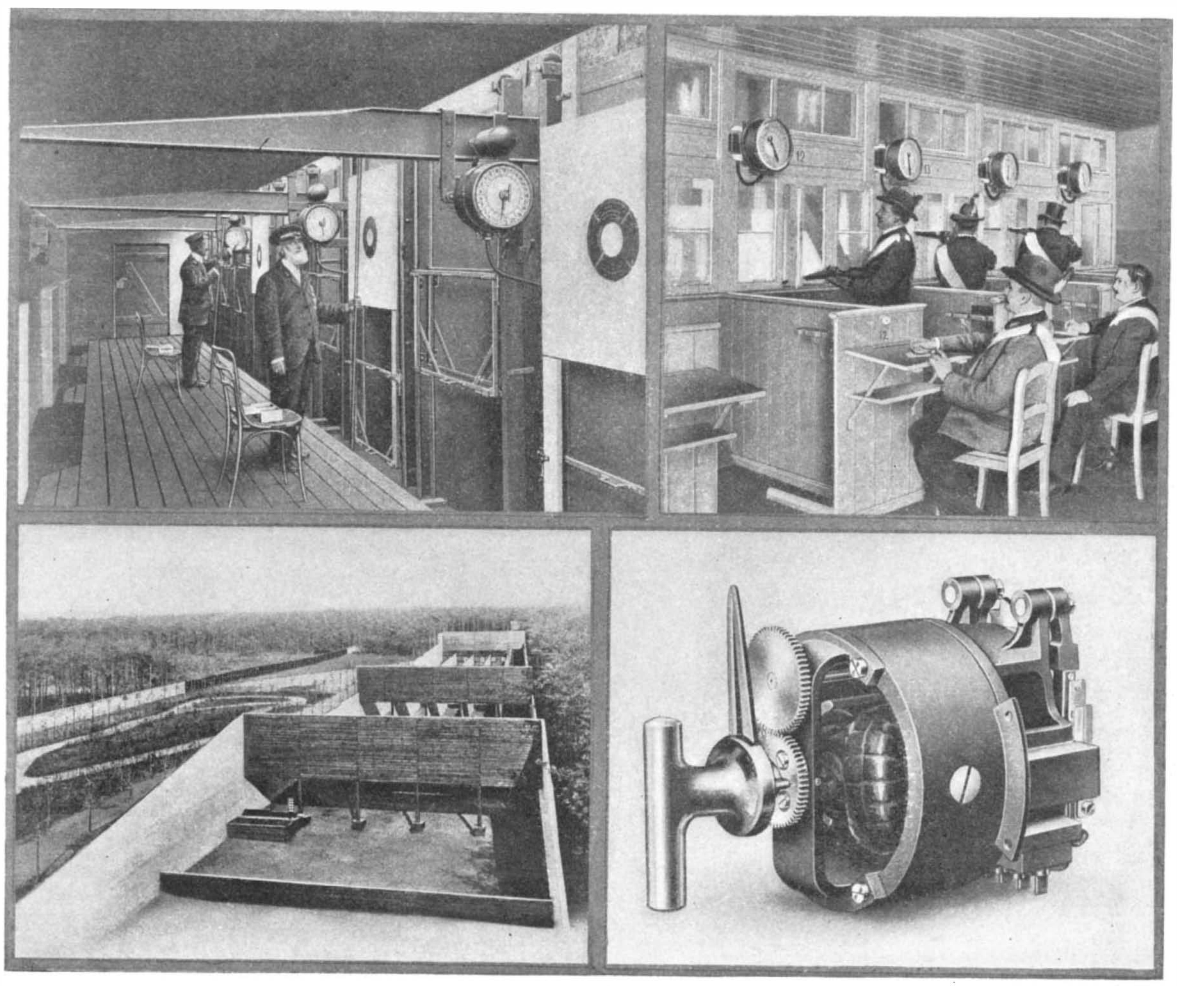
Even more astonishing is the case of the Grapple fruit of South Africa (*Harpagophyton*). This species is of a low growing habit, and bears huge fruits, which are freely adorned with the most formidable barbed appendages. The fruit secures its dispersion in the following manner. In its position on the ground it is liable to be trodden on by sheep, deer, etc. At once, of course, the hooks catch hold and these penetrate into the tender places of the foot, between the horny portions. The unhappy animals limp about, and it may well be weeks before the dreadful burden can be thrown aside. During this time the most dreadful wounds are produced, and as well the creature is very likely to fall a victim to some beast of prey. In this connection a very singular happening sometimes occurs which is well authenticated. A lion captures an antelope with a grapple fruit on its foot. When making his meal, the lion gets the hooked capsule in his jaws, and the barbs speedily become entangled in the mouth parts. The more the lion fidgets, the less likely is he to get rid of the encumbrance, but owing to the pain and annoyance the beast cannot leave his mouth alone. So the miserable business goes forward. Days pass and the lion is quite unable to eat and as a consequence becomes weak and helpless. So the king of beasts dies, killed by the fruit of the Grapple plant.

It is of course recognized that plants must take certain means to protect themselves against the attacks of animals. Some of the measures which have been adopted are positively vindictive. Take the case of the common Stinging Nettle. Here the plant is covered with minute hairs which penetrate the skin, and at the same time inject an irritant poison, the effect of which lasts for hours. Some of the tropical nettles are much more terrible. The following is an account taken from the Himalayan Journals of Sir Joseph Hooker, in which an Indian nettle is described. "This plant, called 'mealum-ma,' attains fifteen feet in height; it has broad glossy leaves, and though apparently without stings, is held in so great dread that I had difficulty in getting men to help cut it down." No wonder the plant is avoided, for if a person is stung by the microscopic hairs the results are appalling. The pain is at first comparatively slight, but after a few hours the affected part feels as if it were being rubbed with a hot iron. Later the most distressing symptoms arise in other parts of the body, which not uncommonly involve the contraction of the muscles of the jaw, and other indications which are similar to those to be observed in a case of lockjaw. In one instance it was nine days before the unhappy individual was free from pain and discomfort. In such a case as this it would seem that a huge amount of unnecessary sufferings is involved. It is possible to protect a plant from attack, as can be seen in many cases, without adopting such brutal methods.

Self defense has been carried to a fine art among desert plants, especially in the case of the Cacti. A formidable array of sharp spines is of course an admirable means of preventing an attack from animals, but many species have carried the matter a good deal further than this. Here the idea seems to be not so much to repel the attack, as to do as much damage to the enemy as possible. In this way an enormous amount of suffering is caused. Some kinds of Prickly Pear (*Opuntia*) have minute barbs on their spines and, if any animal should attempt to attack the plant, or even brush up against it, the spines hold on firmly when driven into the flesh. They are very loosely attached to the plant, so that the unhappy creature takes away a large number of spines when he withdraws. These remain to produce festering wounds, and in this way bring about a large amount of pain. Another kind of Cactus has singular hooked spines as well as those of a more ordinary nature. On this account the species is called the "Wait-a-Bit" plant. Whether it should be the clothes of some passer-by or the tongue of an unfortunate animal the hook holds on, meanwhile the sharp straight spines do deadly work. The tearing away process, if the hook should be buried in flesh, is, as can be imagined, a most painful proceeding.

The instances given above are only a few out of a very large number, which might be brought forward to show that in many ways plants are guilty of great cruelty. One cannot get away from the idea that most of the suffering involved appears to be quite unnecessary, for there are plenty of instances to show that the same ends can be achieved in less painful ways.

A set of transmitters in operation. Receivers installed beside the marksmen.



The shooting ranges at Spandau. The mechanism of the transmitter.

**Electric remote gages for shooting ranges.**

## Electric Remote Gages for Shooting Ranges

**By Our Berlin Correspondent**

ATTEMPTS have occasionally been made to employ electrical apparatus in shooting ranges for signaling the number of the ring hit at each shot, but the arrangements so far devised are of a rather rudimentary description, and could only be used in conjunction with the usual mechanical gages.

The Marksmen's Society at Spandau, near Berlin, has taken a decisive step in this direction, by having all its shooting ranges fitted with electric remote gages of a new system which offers a number of novel features.

The society owns extensive shooting grounds, comprising three 300-meter, twelve 175-meter, two 100-meter ranges, and one 35-meter range. Each range is fitted with a transmitter and receiver, serving to signal the number of the ring hit each time. Each of these apparatus, connected together by electric cables, comprises a scale, the twenty-three divisions of which bear the inscriptions 0, 1, 2, 3 . . . 20, "Telephone," and "Stop." The transmitter is installed to the left of the target, between the guide bars of two contiguous targets, there being no need for providing any special room for it, as in connection with previous installations. The receiver is arranged, in the shooting range, to the left of the marksman, and is readily read and checked by the latter, as well as by the secretary seated immediately behind him. Each transmitter and receiver comprises an index fitted with a handle, which is readily adjusted by hand, the index and handle of the transmitter being connected, in the interior of the casing, with an adjusting arrangement resembling a small electric motor, which insures perfect agreement in the readings of the two apparatus. The index of the receiver is shifted by a similar system, and being protected by a glass plate, cannot be interfered with by the marksman.

With each new reading, marksmen are advised by a short acoustic signal given by an electric buzzer, at the transmitter and receiver, which is readily distinguished from the bell signals employed for other uses. At the marksmen's post and on the desk of the secretary seated behind him, there are push buttons actuating simultaneously the buzzers of the transmitter and receiver, which are distinguished by their different timbre.

The installation further comprises a telephone plant. Watertight telephones, arranged in the passageway of each range, are connected up to an indicator switchboard installed in a special cabin, whence each telephone is readily called. In order to get a connection with his marksman, the man intrusted with the operation of the transmitter has only to adjust the index of the latter to the division "Telephone," thus causing the receiver index to take up immediately the same position and advising the marksman that he is wanted on the telephone. The telephone plant has been designed on the central battery system, the battery being installed so as to be sheltered from atmospheric influences; the telephone apparatus are joined together by means of armored cables.

The installation above described works as follows:

After taking up his post in the shooting range and firing his shot, the marksman presses down the push button on his left, thus actuating the buzzers of his receiver and transmitter and arousing the attention of the operator. The latter looks for the mark left on the target by the shot just fired, pointing out with a small rod, the section in which the mark is bound (top, bottom, right, or left). Having then taken down the target, he adjusts the transmitter index to the number of the rings hit by the marksman. While he is shifting this index, the electric buzzers of the transmitter and receiver are sounded simultaneously, and the receiver index takes up the same position as that of the transmitter. The operator finally pastes some paper on the

(*Concluded on page 639.*)

# The Heavens in July

## A Hundred and Twenty Thousand Years Hence the Tides Will Have Lengthened Our Day by One Second

By Henry Norris Russell, Ph.D.

IN last month's article we considered the singular "secular acceleration" of the moon's motion—that very slow, but steady, shortening of the month whose effects appear unmistakably upon comparison of the recorded observations of classical antiquity with the results of modern investigation. We may now spend a few moments in considering the causes of this phenomenon.

For more than a century after its discovery by Halley it remained entirely mysterious. The first light thrown upon it came from the keen mathematical insight of that great student of the celestial motions, Laplace.

Ever since Newton had discovered the law of gravitation, the difficult question of the manner in which the combined attraction of the Sun and Earth would cause the Moon to move had served to sharpen the wits of the keenest mathematicians. Newton himself had shown how the Sun, by attracting the Earth and Moon in different directions, and with different intensity (according to their varying distances and directions from him) sometimes produced a tendency for the two bodies to separate, and sometimes drew them together. These disturbing forces, though at most amounting to little more than one per cent of the Earth's attraction for the Moon, cause great changes in its orbit. A simple calculation shows that, though the Sun's influence often acts to reinforce the Earth's attraction on the Moon for three or four days at a time, it acts longer and more powerfully in the opposite direction, so that, on the average, through months and years the earth's attraction is diminished. The smaller this attraction, the longer will be the time which a satellite at a given distance will require to complete a revolution; so that the month is actually longer by some 53 minutes than would otherwise be the case.

Now the Sun's disturbing action upon the Moon depends on its average distance from the Earth. If the Earth's orbit around the Sun were always of the same size and shape, this average distance would be invariable, and so would be the length of the month. But the attraction of the planets causes slow changes in the Earth's orbit, and Laplace showed that, though these changes are at present of such a nature that the average distance of the Earth from the Sun is very slowly increasing—not the average of the greatest and least distances reached during the year (this remains constant) but the average of all the distances on the individual days of the year.

Hence the Sun's action in increasing the length of the month is slowly diminishing, and the month is getting a little shorter, century by century, so that the Moon slowly forges ahead of her position calculated without consideration of this fact.

The computation of the exact amount of this change is extremely intricate, but the results of Newcomb and Brown show conclusively that it would set the Moon ahead by 6.1 seconds of arc at the end of a century, or, in other words, would shorten the month by one second of time in 6,000 years.

It is worth remarking that this change will not go on forever. The decrease of the eccentricity of the Earth's orbit, in which it finds its origin, will come to an end about 25,000 years hence, and be followed by an increase, so that the month will shorten for these 25,000 years and then grow longer again.

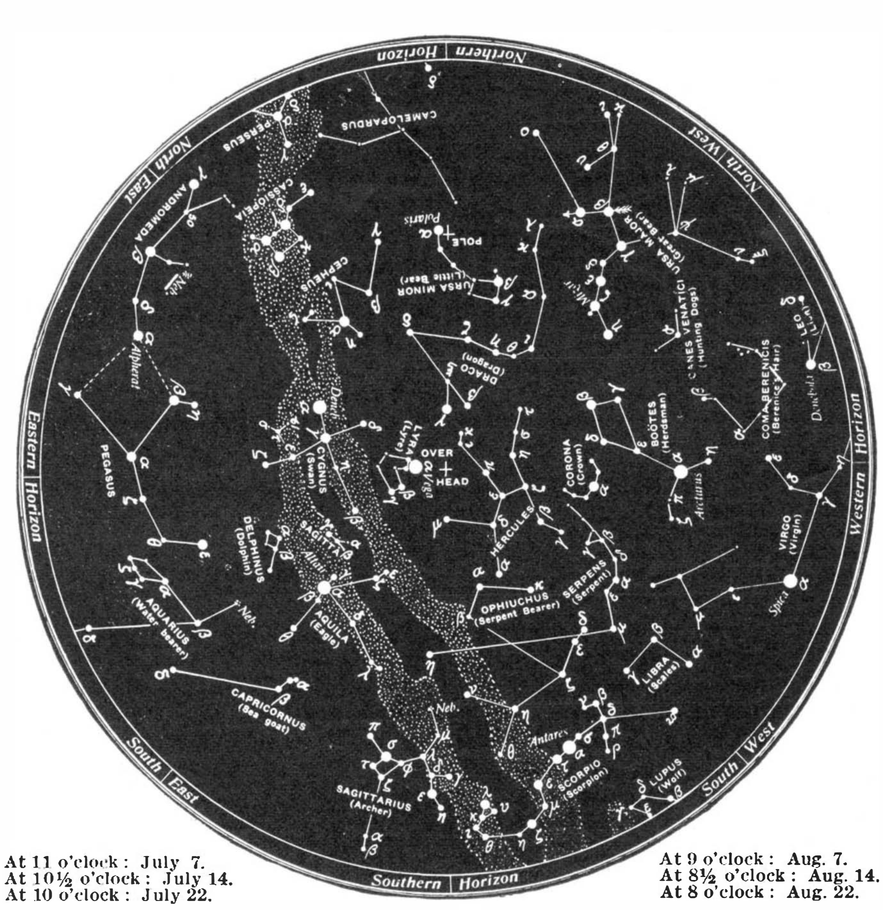
But we are not yet at the bottom of the matter, for the observed rate of change in the month is one second in 3,400 years—about 70 per cent greater than that calculated above. There can be no doubt that the calculations and observations are both substantially correct, and it therefore appears that there must be at least two different causes simultaneously acting to account for the observed change.

Fortunately, another cause is known to exist, namely, the friction of the tides raised by the Moon in the oceans and even in the solid mass of the Earth. Anyone who has seen an old-fashioned tide mill has had visible evidence that the rise and fall of the tides *dissipates energy*—providing power which, if properly directed, can be used to perform useful work, but otherwise is "wasted" in stirring up and heating the tidal currents.

Now this energy must come from somewhere. It is easy to see that the only possible reservoir of energy which the tides can tap is that of the Earth's rotation; for if the Earth kept always the same face toward the Moon, and everything else in nature was the same as now, it would always be high tide (so far as the tides raised by the Moon were concerned) in the same place, there would be no rise and fall of the water on the coast, and no loss of energy by friction.

Hence we see that the tides must act on the rotating Earth very much as a brake acts on a rotating wheel, diminishing its rate of rotation very slowly to be sure, but steadily, and converting the energy of rotation into heat at the points where the brake is applied (i. e., in this case, where the tidal currents run).

In the course of ages, therefore, as the earth rotates more slowly, each day must get a little longer. If the Sun, Moon and planets keep on moving in reality at their original rates, they will go slightly farther in each of the new days than they would have done in the old ones, and so must gradually get ahead of our reckoning, because the Earth, whose rotation we use to set our clocks by, is itself like a clock which is gradually running slower and slower.




At 11 o'clock: July 7.
At 10½ o'clock: July 14.
At 10 o'clock: July 22.

At 9 o'clock: Aug. 7.
At 8½ o'clock: Aug. 14.
At 8 o'clock: Aug. 22.

At 9½ o'clock: July 30.

**NIGHT SKY: JULY AND AUGUST**

In the case of the Moon, the situation is somewhat complicated by the fact that (so to speak) she holds the other end of the brake—the connections being the invisible, but very real, bonds of mutual gravitation. Obviously, in the case of a flywheel, when the brake was clamped on its axle, it would be necessary to tie down the end of the brake lever to prevent its flying around with the axle and wheel. A corresponding force will act on the Moon, urging it forward in the direction of its motion. Calculation shows that the principal effect of this force will be to make the Moon's orbit grow larger, so that she will slowly recede from the Earth. In this larger orbit she will take longer to complete a revolution than in her original orbit, so that the tidal action tends in this way to increase the length of the month measured by a perfect timepiece. Computation shows that, under the existing conditions, this effect is more than compensated by the slowing of the Earth's rotation, so that, measured by our terrestrially adjusted clocks, the Moon will seem to run fast by almost the same amount by which she really goes slow.

To account for the outstanding secular acceleration of the Moon, remaining after allowance has been made for the gravitational action explained above, it is, therefore, only necessary to assume that tidal friction is slowing the Earth's rotation to such an extent that the day becomes one second longer at the end of some 120,000 years.

The similar secular acceleration of the Sun, recently discovered, indicates a more rapid change, amounting to a lengthening of the day by one second in about 25,000 years. The reconciliation of these two values remains as a problem for investigators of this difficult subject—some idea of whose complexity can perhaps be gained from the foregoing account, which deals with only its very simplest phases.

### The Heavens.

The brilliant region of Scorpio and Sagittarius is now full south, and visible at its best. Above this, on the right, is the extensive area of Ophiuchus and Serpens, to the left of which is Aquila. Below this again is Capricornus, with the pretty naked-eye pair which bears the Greek letter Alpha. Beta Capricorni, just below, is also double, having a companion visible in a field-glass.

The great square of Pegasus has just risen, and stands upon one corner in the east. Andromeda is also low, on the northeastern horizon. Cassiopeia and Cepheus are above her, and Cygnus and Lyra are high in the east—the latter almost overhead.

Draco and Ursa Minor are in the north, and Ursa Major in the northwest. The brightest star in the western sky is Arcturus. Spica is below him on the right, and Corona and Hercules are above, on the line toward Lyra.

### The Planets.

Mercury is a morning star this month, being at his greatest elongation on the 18th. At this time he rises about 3:30 A. M. and is easily visible before dawn. He is in the western part of Gemini, and Saturn is close by, the two planets being in conjunction and only 1 degree apart, on the 22nd.

Venus, too, is a morning star, about 5 degrees lower in the sky than the other two and rises about 20 minutes later. She is very much brighter than Mercury, which slightly exceeds Saturn in brilliancy.

Mars is a morning star, too, but is in Taurus, much farther west, and rises at about 1:30 A. M. in the middle of the month. Jupiter is in Pisces, close to the vernal equinox—the departure point from which celestial longitudes and right ascensions are measured—and rises at about 10:30 P. M. in the middle of the month. Saturn is a morning star, practically invisible in the early part of the month, but easily to be seen at its close.

Uranus is in Capricornus, about 2 degrees northeast of the fourth magnitude star Theta Capricorni, and comes to the meridian about 2:30 A. M. at the beginning of the month, and 12:30 A. M. at its close.

Neptune is in conjunction with the Sun on the 23rd, and is invisible this month.

The Moon is in her last quarter at 1 A. M. on the 4th, new at 5 A. M. on the 12th, in her first quarter at 4 P. M. on the 19th, and full at 7 A. M. on the 26th. She is nearest us on the 24th, and farthest away on the 8th. In her circuit of the heavens she comes into conjunction with Jupiter on the 3rd, Mars on the 8th, Venus and Mercury on the 10th, Saturn on the 11th, Neptune on the 13th, Uranus on the 27th, and Jupiter again on the 30th.

On July 5th the Earth reaches its greatest distance from the Sun, 94,400,000 miles; but, since the hemisphere on which we live is tipped toward the Sun, we get about the hottest days of the year.

The comet whose discovery by Delavan was announced last month, turns out to be a new return of Tempel's periodic comet, whose period is five years and two months. This comet, first discovered in 1873, has not been seen since 1904, as at its return in 1910 it was unfavorably placed. It will remain visible in the morning sky for some little time, but will decrease in brightness and soon become inconspicuous telescopically.

Princeton University Observatory.

**A Patent for Second Hand or Used Material in Tire.**—Orwin M. Thomas of Oakland, California, has secured patent No. 1,138,911 for a tire protector in which he provides between the outer casing of the tire and the inner tube a removably seated annular lining which he defines as "consisting of the continuous service-stretched fabric portion of a used outer casing" and described as free from stretching because of its previous use.

## RECENTLY PATENTED INVENTIONS

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

### Of Interest to Farmers.

EGG CARRIER.—M. BARROW, 119 Wooster St., New York, N. Y. The object of the present invention is the provision of a new and improved egg carrier arranged to permit the safe shipping of eggs by parcel post, express companies or other means of transportation. The egg carrier can be cheaply manufactured.

### Hardware and Tools.

SELF LOCKING HINGE.—C. DIENER, 1421 Myrtle Ave., Brooklyn, N. Y., N. Y. In this hinge spring means are provided to hold the leaves of the hinge in different relative positions immovable with respect to each other, the sleeves or knuckles of the hinge plates or leaves being designed to co-operate with each other or with spring-actuated means in order to hold the leaves of the hinge in certain relative angular positions or closed as desired.

SINGLE ACTING JAMB HINGE.—O. KATZENBERGER, 215 W. Huron St., Chicago, Ill. This invention relates to improvements in hinges and particularly to what are known as jamb hinges, and has for an object to provide a structure which may be adjusted so as to cause the door to swing shut or to cause the door to swing open.

### Heating and Lighting.

GAS BURNER AND AUTOMATIC CUT-OFF THEREFOR.—J. E. JARGSTORFF, 137 Henry St., Jamaica, L. I., New York, N. Y. This invention relates to an improved gas burner and automatic cut-off therefor designed to automatically cut off the flow of a gas whenever the flame from any cause becomes extinguished other than by means of the usual cut-off or gas cock controlling the supply to the burner.

GRATE BAR.—C. W. HOPES, Room 1204, 30 E. 42nd St., New York, N. Y. The main object here is to provide such bars which are designed for use in connection with rice, birdseye, or other fine anthracite or bituminous low-grade fuel, whereby said fuel is retained upon the grate and an even distribution of air supplied thereto in order to secure proper combustion, said air being diffused throughout all the fuel on the grate.

### Household Utilities.

MATTRESS.—NANNIE V. KNICKMEYER, Millville, Ga. One of the principal objects of the invention is to provide a mattress having means to facilitate the ready handling of the mattress during the process of shaking up and renovating the same, and in turning and handling the mattress, said means further serving to strengthen and maintain the mattress in shape.

CONVERTIBLE BED AND DIVAN OR SOFA.—J. LUPPINO, 445 55th St., Brooklyn, N. Y., N. Y. The improvement provides a convertible bed and divan or sofa, arranged to permit the user to swing the sections into extended position to form a double bed or into a folded position to provide a divan or sofa, the converting of the bed into a divan or sofa and vice versa requiring very little physical exertion.

BOTTLE AND JAR CLOSURE.—O. A. J. BECHER, Copiague, N. Y. This invention relates particularly to closures for bottles, jars and the like, and the object is to provide a structure which may be quickly applied and removed. It provides a cap or closure for a bottle or jar with a plurality of bent projections acting as threads for engaging and co-acting with the threads on the bottle or jar.

CRULLER CUTTER.—A. VERSTRAETE, 40 North Ave., New Rochelle, N. Y. The improvement relates to hand-operated and directed bakers' implements, and its object is to provide a cruller cutter arranged to permit the baker to quickly and accurately cut a plurality of cruller blanks from a sheet of dough without incurring any waste of dough.

### Machines and Mechanical Devices.

UNIVERSAL STONE WORKING MACHINE. —O. BAUER, 35 Bay 32nd St., Brooklyn, N. Y., N. Y. The invention refers particularly to such machines as are employed in stone cutting or grinding. The invention provides an attachment for an ordinary stoneworking machine whereby the grinding wheel may be adjusted vertically simultaneously with the usual adjustments of the radius arms of the machine.

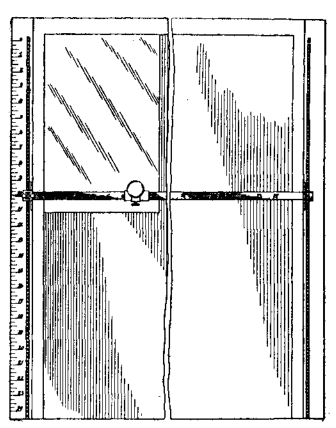
POWER ROCK DRILL.—F. P. PORTER, Kellogg, Idaho. This inventor provides a drill of the hammer type which is especially adapted for drilling holes in the sides of the roof of a mine, and which is arranged to reduce vibrations to minimum, thus allowing easy handling of the machine without undue fatigue on the part of the operator and to withstand hard usage.

RESILIENT TRANSMISSION GEARING.—A. F. DICKEY, Somerset, Pa. In this patent the invention has reference to transmission gearing and has particular reference to means for cushioning the driving action upon such gearing so as to relieve the mechanism from unnecessary shocks, jars or offensive clattering of the parts.

APPARATUS FOR REFINING PULP STUFF AND THE LIKE.—T. H. NASH. Address Day, Davies and Hunt, 321 High Holborn, London, W.C., England. The invention provides a container for mixing the stuff which may be adapted to automatically eliminate or separate pieces of metal or other heavy objects in the stuff, a beating engine comprising one or more beater rolls, and arranged approximately on a level with the container so that the stuff gravitates through the beating engine, a regulable chute or gate connecting the beating engine with the container, and means for returning the stuff from the beating engine to the container.

PHOTOGRAPHIC ROLL HOLDER.—H. B. BARRIER, 2227 E. 3rd Ave., Spokane, Wash. An object here is to provide a device which may be attached to a camera box, and which is designed to hold films with means for pressing the films out flat when exposure is made and for releasing them and permitting their ready movement when shifting from one portion of the film to the other.

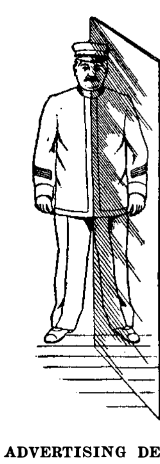
GLASS CUTTING MACHINE.—H. FALVEY, 4 Washington Ave., Parkville, Brooklyn, N. Y., N. Y. This invention relates to glass cutting devices, and particularly to a device for quickly cutting plate glass of any size, and provides an arrangement which will adapt itself to plate glass of different thicknesses, and also glass



GLASS CUTTING MACHINE.

which may not be perfectly flat. It provides a device with a supporting platform for plate glass, and means movable in two directions across the support so as to cut plate glass arranged thereon in two directions and thereby produce a perfectly square product.

ADVERTISING DEVICE.—J. B. FURBER, care of J. L. Hughes, 15 Clinton St., Newark, N. J. The invention involves the use of a manikin representing a half figure, with movable members, such as a leg and an arm, the manikin having concealed support and a mirror being so associated with the manikin that the latter and its reflection will present a complete figure. Illusive effects are produced with respect to the apparently unsupported manikin and the movements imparted to the leg or arm thereof, the illusion being produced through the medium of the mirror and motor-driven actuating devices at the back of the mirror. The device is for display in a store window.



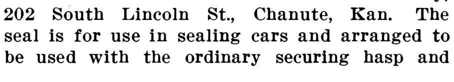
ADVERTISING DEVICE.

### Prime Movers and Their Accessories.

CARBURETER.—H. W. ALLEN, P. O. Box "R," Coalinga, Cal. This inventor provides a device wherein dampers are arranged between the inlet and the outlet of the carbureter for controlling the passage of the fuel and the air therethrough, and wherein a valve is provided for controlling the supply of fuel and wherein a controlling shaft is provided connected to the dampers and to the valve, for simultaneously operating both valve and damper.

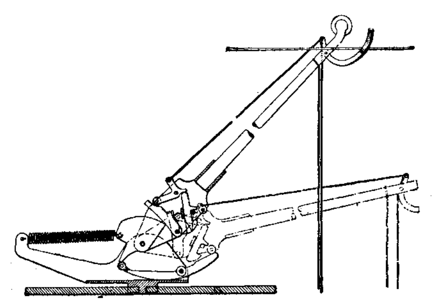
### Railways and Their Accessories.

SEAL.—R. A. EDGAR. Address J. C. Hadley, 202 South Lincoln St., Chanute, Kan. The seal is for use in sealing cars and arranged to be used with the ordinary securing hasp and staple and to be passed through the staple outside of the hasp, and then bent and folded upon itself in such manner that it cannot be detached without breaking the same, and thus indicating clearly to all concerned that it has been tampered with. The invention is an improvement on Mr. Edgar's prior Patent No. 933,700.




SEAL FOR CARS.

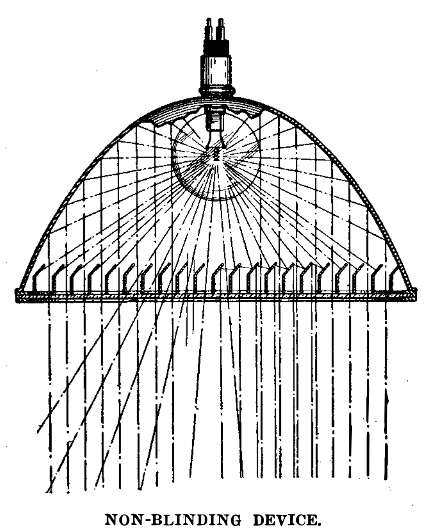
TROLLEY POLE.—J. DE ANGELIS, 40 W. 5th St., Mount Vernon, N. Y. This invention relates to trolley poles for electric railway cars or the like, and has particular reference to means for facilitating the engagement between the trolley and the overhead wire and also means of an improved nature to prevent damage to the pole or any other mechanism in the event of the trolley leaving the wire while in use.



TROLLEY POLE.

### Pertaining to Vehicles.

NON-BLINDING DEVICE.—E. ADERENTE, 145 Sherman Ave., Jersey City, N. J. The device is adapted to be applied to high power headlights for automobiles and the like, the device being preferably, although not necessarily, in the nature of an attachment applied to the glass of the lamp for the purpose of so influencing the rays that they will practically all be directed on the road or street surface without producing any blinding effect upon pedestrians or occupants of other vehicles, since the rays of light are directed forwardly in a line below the ordinary level of sight.



NON-BLINDING DEVICE.

OPERATING DEVICE FOR MOVABLE HEADLIGHTS.—M. GRIMORD. Address S. J. MCKINNON, 1114 Williard St., Ann Arbor, Mich. The invention provides a headlight control, including a connection between the reach rod and the lights, this connection being of such a flexible nature as to allow vertical movement of the rod relatively to the lights due to the movements of the vehicle in its road work, without resulting in any movement of the headlights, thus insuring a steady and unflickering light.

### Designs.

DESIGN FOR A DOLL.—T. H. HINDLE, JR., 2905 Avenue F, Brooklyn, N. Y., N. Y. This ornamental design represents an infant in standing posture, with arms extended and a startled expression of face.

DESIGN FOR FABRIC.—SOPHIE L. CROWNFIELD, care of E. F. Tirume & Son, 251 4th Ave., New York, N. Y. In this ornamental design for fabric, the attractive feature consists of an extremely original representation of patterns of irregular and sinuous form.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

WE wish to call attention to the fact that we are in a position to render competent services in every branch of patent or trade-mark work. Our staff is composed of mechanical, electrical and chemical experts, thoroughly trained to prepare and prosecute all patent applications, irrespective of the complex nature of the subject matter involved, or of the specialized, technical, or scientific knowledge required therefor.

We also have associates throughout the world, who assist in the prosecution of patent and trade-mark applications filed in all countries foreign to the United States.

MUNN & Co.,
*Patent Solicitors,*
233 Broadway,
New York, N. Y.

Branch Office:
625 F Street, N. W.,
Washington, D. C.

## LEGAL NOTICES



## Classified Advertisements



## INQUIRIES

*Inquiry No. 9449.* Wanted the name and address of a manufacturer who is prepared to build a new and very simple stationary engine with or without gas producer.

*Inquiry No. 9450.* Wanted the name and address of a manufacturer who can build a light simple motor for light automobiles and for portable farm work.

## Aeronautic Lessons of the European War

*(Concluded from page 627.)*

course of events has also shown that, after all, the "despised" German aeroplanes and dirigibles left little to be desired in this direction. It seems a foregone conclusion that the war will lead to a revision of notions about types of craft and of armament and to practising aerial attack and tactics in peace time as now destroyers fight sham battles. The Germans hardly ever dreamed of practising maneuvering for aerial combat before the war. Otherwise their types would be surely more versatile and the accounts of aeroplane duels would read differently. There is one peculiar, novel side to this air fighting. Never before in all warfare (barring "Leather-stocking Tales") has personal marksmanship evidently been at so high a premium. German writers have been complaining that it is the rarest chance if the same man shows the highest talent equally as a pilot and observer. Consequently, the Germans standardized the two-man machine. To be a virtuoso with a rifle is just as unique an accomplishment, to say the least. In future, lack of gifts for quick marksmanship will no doubt lead to the quitting of many an observer (just as it evidently accounts for the enigmatical turn of many encounters—English flyers are sportsmen). Those flyers who remain in the service (aeroplanes are costly implements), both pilots and observers, will enjoy ceaseless target practice. The natural development would be to ransack the whole army for perfect marksmen of minimum weight and ship three instead of two men, at least for short-range scouting, aboard the powerful Taubes and Albatross. Certainly the destruction of a Zeppelin will be followed by a revision of crews and shipping some crack shots on each. It seems strange that aboard the light, fast monoplanes shotguns are not also carried.

The "personal equation" in this experimental air-war shows also, especially in the handling of high-angle artillery, as some gun commanders on either side are given sobriquets and a wide berth by the flyers. An interesting detail is the fact that modern high-velocity bullets have ignited the gasoline in fuel tanks they perforated. Fibrous non-metallic tanks from which no sparks are struck may become a feature of future war machines. As Capt. Hacker (Count Zeppelin's aide) explained to the writer, the firing of the dirigible "Schwaben" by collision with the ground, from the fact that tearing steel wires let sparks fly, might shed some light on the Austrian report (contradicted by the Italian) that the dirigible "Citta de Ferrara" was ignited by a stream of aeroplane bullets. (This type has metal parts close to the gas bag.) Modern bullets are too tiny to be made incendiary shells. An inventor with such a purpose had recently to fall back on a discarded large caliber rifle. Such feats of dirigible destruction may be a matter of luck, just as the Zeppelin was hit only by the sixth bomb. Even this was the first performance of its kind. It seems that aviators have now learned the advisability of discharging all their bombs at once. The tiny steel bolts, occasionally dropped from aeroplanes, deserve hardly more than a passing mention. We may yet see a more businesslike brand, in larger quantities and slightly heavier, dumped from Zeppelins. Who could ever have foreseen that so bold a fancy as the proverbial "rain of pitchforks" might yet literally come true!

## The Instrumental Study of the Heart

*(Concluded from page 631.)*

of survival and the composition of artificial serums, we begin to appreciate the benefits that surgery has derived from laboratory experiments and the hopes raised by such bold attempts as those of Carrel and Tuffier.

These survivals and revivals of organs suggest the question: What is death and when does it occur? In point of fact, nothing is more certain than death, and nothing is more uncertain than the mo-

*(Concluded on page 639.)*

# INDEX

**Note.—Illustrated articles are marked with an asterisk (*). Look for the general subject rather than the supposed specific titles of articles. Thus: "Aeronautics," "Automobiles," "Meteorology," "Panama Canal," etc., will give related articles much more quickly than by reference to the title.**

## A



## B



## C



## D



## E



## F



## G

ment of its coming. Death advances by stages and of all living beings man is least able to resist it. Many lower organisms survive very extensive mutilation. Frogs leap after the removal of their heart and lungs. A tortoise moved its legs eleven days after decapitation; another lived six months without a brain. Humboldt saw a condor, which had been strangled and hung, walk as soon as it was released, and stand erect after being shot four times in the neck, breast and abdomen. A beetle half devoured by ants continued crawling normally and, according to Treviranus, a grasshopper moved its legs and antennae five months after it had been disemboweled and pinned to a board.

Susceptibility to death, therefore, appears to be associated with complexity and perfection of organic development.

### Electric Remote Shooting Gages

(*Concluded from page 633.*)

mark made by the bullet, after which the target is ready for another shot.

The first cost of this electrical outfit is, in most cases, more than made up by the saving in ground and accommodations. Operating expenses are exceedingly low. At Spandau, three-phase current at 220 volts, 50 cycles, is available for feeding the apparatus, thus allowing a very simple type of alternating current gage to be used. The 18 shooting ranges are arranged in six groups of three, and as each group has an armored underground cable of its own, any breakdown in operation will be limited to the three ranges of a given cable. Each group communicates with the electric mains through a transformer, stepping down the tension from 220 to 55 volts. The consumption of energy of each transmitter-receiver set is about 28 watts.

### Wire Rope

ALTHOUGH wire rope has been used as a mechanical appliance for almost 5,000 years, it is commonly regarded as a modern invention. During the many years which have elapsed since the first records of its use, wire rope has passed from a crude to a highly developed product, and the purposes for which it is employed have increased a thousandfold. In no other branch of the American steel industry is there so great a demand for material of proven integrity, for it might be safely suggested that wire rope is born to be abused. It is subjected to tremendous tensile strains; it must withstand constant bendings; abrasion, corrosion, and the peculiar internal stresses produced by vibration.

Wire rope, as it is made to-day, is the product of the metallurgist and the mechanic. Every process from the smelting of the ores, the cold drawing of the wires and the heat treatments they receive down to the stranding, or laying up, of the cable, is conducted with mathematical precision.

The chemist sees that only steel of the proper analysis is used; the electric pyrometer insures uniformity of heat treatment and various testing machines clearly develop the worth of the product before it is allowed to leave the mill. Wire rope is used in mine shafts more than a mile in depth, and may be found on aeroplanes which sail a mile or more above the ground.

A Boston firm has just been furnished with 3-inch diameter dredge-rope which has a strength of more than 645,000 pounds. The same mill that turned out this product makes the 1/16-inch cable which is embedded in automobile tires for re-enforcing purposes.

Wire rope is made for guying the poles of circus tents and then the tight-rope walkers and the ballet performers are provided with the means to display their arts in wire of the finest strand, but of surest strength.

Civilization is to a very great extent indebted to the wire-rope makers—for without them stores of minerals such as coal and copper would be virtually inaccessible; the construction of high buildings impossible, and the development of the country's every resource a hopelessly tedious task.

# GOODYEAR CORD TIRES

## *An 11-Year Attainment*

The Goodyear Cord Tire has suddenly attained a multiplied popularity. The demand has lately increased tenfold. Many owners of fine cars are now adopting these Cord Tires. Some high-priced cars will soon come equipped with them. So Goodyear Cord Tires rather dominate now in new interest.

### Not a New Type

The Cord Tire itself is not new. We have built Cord Tires since 1904. The English-French type, built abroad, is older still, but it never attained great vogue. Its virtues were dimmed by too many shortcomings, including high cost per mile. But, starting with that, we have for 11 years been building and bettering Cord Tires.

Cord Tires, *in cost per tire*, may exceed other types somewhat. The construction is rather expensive. Our aim has been to make extra mileage offset that higher cost. And the present popularity of Goodyear Cord Tires is due to our success.

### Multiplying Mileage

Goodyear Cord Tires, to this end, are built greatly oversize. That adds to tire life.

Then Goodyear Cord Tires have from 6 to 10 cord layers. Our 4-inch Cord Tire is an 8-ply tire. Our larger sizes are 10-ply. That means extreme reinforcement. Goodyear Cord Tires have our No-Rim-Cut feature, which combats a major waste.

These three great improvements—each exclusive to Goodyear—have multiplied Cord Tire mileage. Yet they sacrifice no iota of resiliency or comfort. And they add no extra price. Goodyear Cord Tires cost about the same as others of this type. Then, to make them utterly secure, we vulcanize 126 braided piano wires into each tire base. Goodyear Cord Tires need no hooks on the base—those hooks which "freeze" into the rim flange. For front wheels they come with a heavy grooved tread which aids steering. For rear wheels they come with our All-Weather tread, tough and double thick, with resistless sharp-edged grips. Those are some Goodyear supremacies.

### Cord Tire Virtues

Goodyear Cord Tires are tires of super-comfort. They are wondrous shock-absorbers. Never was a Cord Tire more resilient. Never was one better adapted to minimize trouble, give unusual mileage, increase speed and save power.

On electric cars, Cord Tires have long been the only advised pneumatics. Ease and comfort were most appealing there, and power-saving was of prime importance. Goodyear Cord Tires on electric cars add from 25 to 30 per cent to the mileage per charge. Now, with Goodyear improvements, many gasoline car owners are adopting these comfort tires.

When you come to Cord Tires insist on the Goodyear perfections. In them will lie this type's permanent popularity. Most electric car makers supply Goodyear Cord Tires on request. Most gasoline car makers who do not equip with them will supply them.

Any Goodyear dealer can get them for you. Any Goodyear branch —in 65 cities—will direct you to a stock.

THE GOODYEAR TIRE & RUBBER COMPANY
AKRON, OHIO

GOODYEAR SUPREMACIES
Great Oversize
6 to 10 Cord Layers
No-Rim-Cut Feature

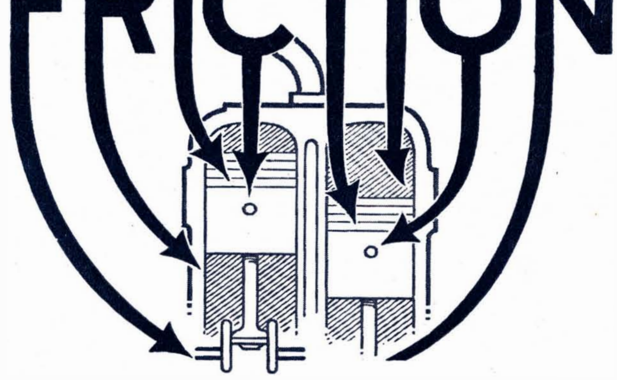
GOODYEAR SUPREMACIES
126 piano-wire base
All-Weather Treads

All-Weather Tread

Ribbed Tread

GOOD YEAR
AKRON, OHIO
CORD TIRES

# FRICTION



# The Destroyer of Steel

Like the weight of an extra passenger, friction always rides with you.

It drags at your bearings. It robs you of power. It wears down metal. There are several thousand piston-strokes in a cylinder for each mile the car runs.

As friction can never be entirely overcome, it is imperative then that you use the best possible friction reducing oil for *your* motor.

Unless the *body* of your oil is adapted to *your* motor and feed system, it will not properly distribute between the moving parts.

And, unless its *quality* or lubricating efficiency is of the highest, it too quickly "wears out" under the constant rubbing under the moving metal surfaces.

At the right we print a scientific Chart of Automobile Recommendations. This Chart for a number of years has been the motorist's standard guide to correct lubrication.

The *body* of the oil specified for your car in this Chart enables it to feed in correct quantities to every friction point.

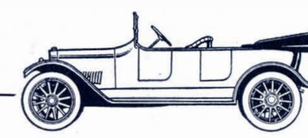
After it reaches these friction points, its *quality* assures a constant and proper oil cushion.

That oil cushion is your only insurance against premature motor wear.

It is your only safeguard against the noisy complaints of worn-down metal parts.

If you want to make certain of this protection, note down the grade of Gargoyle Mobiloils specified for your car. Then ask for that grade and see that you get it.

If your car is not listed in the partial chart at the right, send for the complete Chart which embraces 585 makes of car.



### Correct Lubrication

*Explanation:* In the Chart below, the letter opposite the car indicates the grade of Gargoyle Mobiloils that should be used. For example, "A" means Gargoyle Mobiloil "A". "Arc" means Gargoyle Mobiloil "Arctic," etc. The recommendations cover all models of both pleasure and commercial vehicles unless otherwise noted.

| MODEL OF CARS | 1911 Summer | 1911 Winter | 1912 Summer | 1912 Winter | 1913 Summer | 1913 Winter | 1914 Summer | 1914 Winter | 1915 Summer | 1915 Winter |
|---|---|---|---|---|---|---|---|---|---|---|
| Abbott Detroit | A | Arc. | A | Arc. | A | Arc. | Arc. | Arc. | Arc. | Arc. |
| " " (8 cyl) | | | | | | | | | A | A |
| Alco | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | | | | |
| American | A | Arc. | A | Arc. | A | Arc. | A | Arc. | | |
| Apperson | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. |
| Auburn (4 cyl) | A | A | A | A | A | A | A | A | A | Arc. |
| " (6 cyl) | | | | | | | Arc. | Arc. | Arc. | Arc. |
| Autocar (2 cyl.) | A | Arc. | A | Arc. | A | Arc. | A | Arc. | A | Arc. |
| " (4 cyl.) | A | Arc. | A | Arc. | | | | | | |
| Avery | A | E | A | A | A | A | A | A | A | A |
| " (Model C) 1 Ton | | | | | | | Arc. | Arc. | Arc. | Arc. |
| Buick | A | Arc. | A | Arc. | A | Arc. | A | Arc. | Arc. | Arc. |
| Cadillac | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | | |
| " (8 cyl) | | | | | | | | | Arc. | Arc. |
| Cartercar | A | E | A | E | A | E | Arc. | Arc. | Arc. | Arc. |
| " Com'l | A | Arc. | A | Arc. | A | Arc. | | | | |
| Case | A | A | A | Arc. | A | Arc. | A | Arc. | A | Arc. |
| Chalmers | A | Arc. | Arc. | Arc. | Arc. | Arc. | A | A | Arc. | Arc. |
| Chandler | | | | | | | Arc. | Arc. | Arc. | Arc. |
| Chase (air) | B | B | B | B | B | B | B | B | B | B |
| " (water) | | | | | | | Arc. | Arc. | Arc. | Arc. |
| Chesterfield six | | | | | | | | | A | Arc. |
| Chevrolet | | | | | A | A | A | Arc. | Arc. | Arc. |
| Cole | A | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. |
| " (8 cyl) | | | | | | | | | A | A |
| Cunningham | A | A | A | A | A | A | Arc. | Arc. | Arc. | Arc. |
| Delaunay-Belleville | B | A | B | A | B | A | B | A | | |
| Detroiter | | | A | Arc. | A | Arc. | A | A | A | Arc. |
| " (8 cyl) | | | | | | | | | Arc. | Arc. |
| Dodge | | | | | | | | | E | E |
| E. M. F. | Arc. | Arc. | Arc. | Arc. | | | | | | |
| Empire | A | Arc. | A | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. |
| Fiat | B | A | A | A | B | A | B | A | B | A |
| Flanders | E | E | Arc. | Arc. | | | | | | |
| " (6 cyl.) | | | | | Arc. | Arc. | | | | |
| Ford | E | E | E | E | E | E | E | E | E | E |
| Franklin | A | Arc. | A | Arc. | A | Arc. | A | A | A | A |
| " Com'l | B | A | A | Arc. | A | Arc. | | | | |
| Garford | A | E | Arc. | Arc. | Arc. | Arc. | | | | |
| " Com'l | A | Arc. | Arc. | Arc. | Arc. | Arc. | A | A | | |
| Grant | | | | | | | Arc. | Arc. | Arc. | Arc. |
| Havers | A | Arc. | A | Arc. | A | Arc. | A | A | | |
| " (Model 6-60) | | | | | | | Arc. | Arc. | | |
| Haynes | A | Arc. | A | Arc. | A | Arc. | A | Arc. | A | Arc. |
| Hudson | A | Arc. | A | Arc. | A | Arc. | Arc. | Arc. | Arc. | Arc. |
| Hupmobile | | | | | A | Arc. | A | Arc. | A | Arc. |
| " (Model 20) | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | | | | |
| I. H. C. (air) | | | | | B | A | B | A | B | A |
| " (water) | | | | | A | A | A | A | A | A |
| International | B | B | B | A | | | | | | |
| Interstate | A | Arc. | A | Arc. | A | Arc. | A | Arc. | A | Arc. |
| Jackson | A | Arc. | A | Arc. | A | Arc. | Arc. | Arc. | Arc. | Arc. |
| Jeffery | | | | | | | A | A | A | Arc. |
| " Com'l | | | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | A | Arc. |
| Kelly Springfield | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | A | A | A | A |
| King | A | E | A | E | A | E | A | A | A | Arc. |
| " (8 cyl) | | | | | | | | | Arc. | Arc. |
| " Com'l | | | | | | | Arc. | Arc. | Arc. | Arc. |
| Kissel Kar | A | Arc. | A | Arc. | A | Arc. | A | Arc. | A | Arc. |
| " " Com'l | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | A | Arc. | A | Arc. |
| " " (Model 48) | | | | | | | A | A | A | A |
| Kline Kar | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | A | Arc. | A | Arc. |
| Knox | B | A | B | A | B | A | B | A | B | A |
| Krit | A | A | A | A | A | A | A | A | A | Arc. |
| Lippard Stewart | | | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. |
| Locomobile | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | E | E | E | E |
| Lozier | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | A | Arc. | | |
| Lyons Knight | | | | | | | A | A | B | A |
| Mack | A | E | E | E | E | E | A | E | A | E |
| " (Model S) | | | | | A | A | A | A | A | A |
| Marion | A | E | A | Arc. | A | Arc. | Arc. | Arc. | Arc. | Arc. |
| Marmon | A | Arc. | A | Arc. | A | Arc. | A | Arc. | A | Arc. |
| Maxwell | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. |
| Mercer | A | Arc. | A | Arc. | A | Arc. | A | Arc. | A | Arc. |
| " (22-70 Series) | | | | | | | | | Arc. | Arc. |
| Metz | B | Arc. | A | Arc. | A | Arc. | A | Arc. | A | Arc. |
| Mitchell | A | Arc. | A | Arc. | A | Arc. | A | Arc | A | Arc. |
| Moline | A | Arc. | A | Arc. | A | Arc. | | | | |
| " Knight | | | | | | | A | A | A | A |
| Moon (4 cyl.) | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | A | Arc. | Arc. | Arc. |
| " (6 cyl.) | | | | | | | Arc. | Arc. | Arc. | Arc. |
| National | A | A | A | A | A | A | A | A | A | Arc. |
| Oakland | A | Arc. | A | Arc. | A | Arc. | Arc. | Arc. | Arc. | Arc. |
| Oldsmobile | A | Arc. | A | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. |
| Overland | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. |
| Packard | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | A | Arc. | A | Arc. |
| Paige | A | Arc. | A | E | A | E | A | A | A | Arc. |
| " (6 cyl) | | | | | | | | | Arc. | Arc. |
| Pathfinder | | | | | A | Arc. | Arc. | Arc. | Arc. | Arc. |
| Peerless | Arc | Arc | Arc. | Arc | Arc. | Arc | Arc. | Arc. | Arc. | Arc. |
| Pierce Arrow | A | Arc. | A | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. |
| " " Com'l | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc | Arc | Arc. | Arc. |
| Pope Hartford | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | | |
| Premier | A | Arc. | A | Arc. | A | Arc. | A | Arc. | A | Arc. |
| Rambler | A | Arc. | Arc. | Arc. | Arc. | Arc. | | | | |
| Regal | A | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. |
| Renault | A | Arc. | A | Arc. | A | Arc. | A | Arc | A | Arc. |
| Reo | A | Arc. | A | Arc. | A | Arc. | A | Arc | A | Arc. |
| S. G. V. | B | Arc. | B | Arc. | B | Arc. | A | Arc. | A | Arc. |
| Saurer | A | Arc. | A | Arc | A | Arc. | Arc. | Arc. | Arc. | Arc. |
| Saxon | | | | | | | E | E | E | E |
| Selden | A | E | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. |
| Simplex | Arc | Arc. | Arc. | Arc. | Arc. | Arc | Arc. | Arc. | Arc. | Arc. |
| Speedwell | A | Arc. | A | Arc. | Arc. | Arc | Arc | Arc. | Arc. | Arc. |
| " Mead | | | | | A | Arc. | B | A | B | A |
| Stearns | A | Arc | A | Arc. | | | | | | |
| " Knight | | | A | A | A | A | B | A | B | A |
| " " (Light 4) | | | | | | | | | A | Arc. |
| Stevens Duryea | Arc | Arc | Arc | Arc | Arc. | Arc | Arc | Arc. | Arc. | Arc. |
| Stoddard-Dayton | A | A | A | A | A | A | | | | |
| " " Knight | | | A | A | A | A | | | | |
| Studebaker | A | Arc. | Arc | Arc | A | Arc | A | Arc | Arc. | Arc. |
| Stutz | | | Arc. | Arc | Arc. | Arc | A | A | A | A |
| Velie (4 cyl.) | A | Arc. | A | Arc | A | Arc | A | Arc. | A | Arc. |
| " (6 cyl.) | | | | | | | Arc. | Arc. | Arc | Arc. |
| Walter | Arc | Arc. | Arc | Arc | Arc | Arc | Arc. | Arc | A | A |
| White | Arc | Arc | Arc | Arc | Arc | Arc | Arc | Arc | Arc. | Arc. |
| Willys Knight | | | | | | | A | A | B | A |
| " Utility | | | | | | | A | Arc | Arc | Arc |
| Winton | Arc | Arc | Arc | Arc. | Arc | Arc | Arc. | Arc | Arc. | Arc. |

GARGOYLE

# Mobiloils

*A grade for each type of motor*

The four grades of Gargoyle Mobiloils, for gasoline motor lubrication, purified to remove free carbon, are:

**Gargoyle Mobiloil "A"**
**Gargoyle Mobiloil "B"**
**Gargoyle Mobiloil "E"**
**Gargoyle Mobiloil "Arctic"**

***For Electric Vehicles*** use Gargoyle Mobiloil "A" for motor and enclosed chains. For open chains and differential use Gargoyle Mobiloil "C."

In buying Gargoyle Mobiloils from your dealer, it is safest to purchase in original packages. Look for the red Gargoyle on the container. For information, kindly address any inquiry to our nearest office.

VACUUM OIL COMPANY, Rochester, N. Y., U. S. A.

**Specialists in the manufacture of high-grade lubricants for every class of machinery. Obtainable everywhere in the world.**

*DOMESTIC BRANCHES:* Detroit, Boston, New York, Chicago, Philadelphia, Indianapolis, Minneapolis, Pittsburgh